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THE ECONOMICS OF RAIL TRANSPORT IN GREAT BRITAIN

VOLUME II
RATES & SERVICE

BY

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FOREWORD

By Sir GUY GRANET, G.B.E.

"The wealth of any country depends very largely on the efficiency of its transport system."

Like all truisms, this requires to be emphasized and explained. Mr. Sherrington in this book has set himself the task of making it clear not only to the trained railway man and the trader, but to the general reader.

In his first volume he has traced the history and development of rail transport in this country. In his second volume, after an introductory chapter on the economic function of rail transport, he explains the organization and the administration of railways, some of their operating methods and objects, and their relations with traders, the public, and the State.

Mr. Sherrington has not only—in the study and teaching of economics and transport questions at Cambridge, Cornell and London Universities—had an unusual equipment for his task upon the academic or theoretical side; he has also had to handle his subjects, with no uncertain grasp, in their practical aspects. As Secretary of the Railway Research Service, located in the London School of Economics, but sustained by and on behalf of our great railways, his reports and surveys of the conditions abroad would be of little use if they were not imbued with a strong practical spirit. And whether it is the result of travel abroad in inquiring into the working of an eight-hour day under the Washington Convention, or car retarders in hump shunting yards, or automatic train control, or the carriage of coal, or rates policies, or operating results abroad, he has brought a grasp of both general principle and practical considerations into service to an unusual degree, and practical railwaymen

are learning to appreciate the qualities of his work to an increasing extent.

There never was a time when the efficient working of our railways was so important to our industries as it is to-day.

I believe that our English railways have attained a high standard of efficiency, and I think it is a good augury for their continued progress that they are making such increasing and practical use of the trained mind of the author of this book; but there is no doubt, as Mr. Sherrington points out, that we are far behind some other countries in co-operative organization with our traders.

If on the one hand he can convince our railwaymen that their equipment is deficient in this respect, and if on the other hand he can induce traders to read this book and to understand some of the difficulties that confront the railways, his labours will have been amply justified.

PREFACE

In writing this book, I have endeavoured to stress the importance of studying the development of the British railway system prior to any attempt at analysing the economics of rail transport at the present time in Great Britain. It is exceedingly difficult to understand the present position and the many problems which surround such questions as the private ownership of railway wagons, the level of rates, and fares, or the organization of the railways in their relationship to the social welfare of the community, without the background of economic history during the last hundred years. Unfortunately, it was found impossible to include the history and development in addition to the discussion of railway economics within one volume without the inconvenience of size, which would seriously detract from the value of such a book. It is hoped, however, that so far as is possible the two volumes will be read in conjunction one with another. The dearth of economic literature concerning transport in Great Britain is acknowledged universally by all those teaching the subject, and this want makes very difficult the verification of facts and figures relative to early railway history. Further, it is clear that developments are taking place every day, so that no book of this nature can be absolutely up-to-date—a tribute in itself to railway progress and efficiency.

I would wish to return the sincerest thanks to Mr. H. Grote Lewin—perhaps the greatest living authority on early British railways, as evidenced by his book, *Early British Railways*, 1801–1844. He has been kind enough to check for me the chapters on Early British Railways, and on the History of the Southern Railway. Railway history must largely be checked by a study of contem-

porary technical periodicals, such as *Heropath's Journal* and the *Railway Times* ; and for modern information, the *Railway Gazette*, the *Locomotive* and *Modern Transport*. While references cannot be made in the book for each individual piece of information, I gladly pay tribute to the valuable work which was done by the technical periodicals during the nineteenth century, and is being done by their present successors. Where so few books exist dealing with the subject, the debt due to the technical press is very large.

To Mr. R. Bell, Assistant General Manager, L.N.E.R., I owe much for his kindness in allowing me to have the history data relative to that Company checked and verified. I owe, also, similar debts of gratitude to Sir Felix Pole, General Manager, G.W.R., and to Sir Josiah Stamp, Chairman and President, L.M.S.R., as also to Mr. Quirey, Vice-President, L.M.S.R. Mr. R. W. Reid, Vice-President, L.M.S.R., has been good enough to assist me with advice as to the chapters on Carriage and Wagon Design ; while Mr. R. E. L. Maunsell, Chief Mechanical Engineer, S.R., kindly commented on the chapter dealing with Locomotive Development, as did Mr. W. A. Willox, of the same railway, with regard to the chapter on Permanent Way.

Although every care has been taken to verify and check dates, figures, and so forth, I realize, notwithstanding, that probably errors have crept in, due to the impossibility in many cases of finding more than one single source of information. My thanks are also due to Mr. Cyril Hurcomb, Permanent Secretary to the Ministry of Transport, for certain figures ; and also to Professor Kidd of Pittsburgh (U.S.A.), Mr. G. J. Ponsonby, Mrs. Clement Edwards, and to my father, Sir Charles Sherrington, for valuable comments. I am also greatly indebted to Mr. P. H. Price and to Mr. Painter, of the Railway Clearing House, for having so kindly checked the chapter on the development of that all-important institution, while thanks are also due to the Railway Economics Bureau at Washington for certain information.

The book is designed to be of assistance not only to

the student of railway economics, but also as a reference book for those in a position of responsibility on the home railways and those abroad. It is hoped further that to economists interested in transport it may prove useful in giving a bird's-eye view of the economic problems of the most vital of home industries.

Lastly, for her invaluable help comprising the verifying of the data cited, I render grateful acknowledgment to my wife.

C. E. R. SHERRINGTON.

May 24th, 1928.

CONTENTS

CHAP. PAGE

I ECONOMIC FUNCTION OF RAIL TRANSPORT . . . 1

The most important industry—The social aspect as applied to railways—Travel originally undertaken for trade—The secret of our industrial supremacy—The economic effect of railway construction—Territorial specialization—The value of cheap transport facilities—The unifying influence of railways—Effect of transport costs on prices.

II INTERNAL ORGANIZATION 12

The problem of choice of organization—Larger systems tend to more efficient internal organization—Grouped lines abroad—Difficulties in Great Britain—A typical pre-grouping organization—The Departmental and Divisional systems, their advantages and disadvantages—The L.M.S.R. organization—A semi-divisional type, the L.N.E.R.—The S.R. and G.W.R. mainly departmental—Internal organization discussed—The engineering department, a difficulty—Co-operation between departments essential—A railway organization in outline.

III BRITISH RAILWAY FINANCE. CAPITAL: REVENUE: EXPENDITURE 28

Parliamentary procedure—Many kinds of capital—The meaning of "capital"—Total Capital Receipts—Exceeded by Total Capital Expenditure—Capital of the "Big Four"—Dividends of 1913 and 1925—Stocks and shares—Bonds and debentures—The need for interest—The splitting of shares—Proportion of stocks to debentures important—The characteristics of railway capital—Ancillary services, and the revenue derived therefrom—Percentages of passenger and freight traffic receipts—Difficulties of division of expenditure—Main features of expenditure—The operating ratio—Net income—Sources from which statistics are derived—The Annual Report—and the Accounts contained therein.

IV THE RAILWAYS AND THE TRADER 59

Co-operation an essential to maximum advantage of the railways and their users—British practice backward in co-operative organization—Advisory Committees in India—In France, Superior Railway Council acts as medium—No special body in Great Britain—1921 Act sets up Railway Rates Tribunal and suggested Local Joint Committees—Lack of success of the latter—District Councils in Germany—The United States Shippers' Advisory Boards—Their phenomenal success—Traders' Co-ordinating Committee cannot be compared.

CHAP. PAGE

V THE RAILWAY CLEARING HOUSE 71

Commencement of the Railway Clearing House in 1842—Original company members—Growth slow but sure—Railway Clearing Act of 1850—Main objects of the Clearing House—Three departments—The Secretarial (including Mileage Section)—Work of the Common User Committee—The Merchandise Department—Division of goods receipts—The Coaching Department arranges division of passenger receipts—Parcels traffic also dealt with—The Railway Clearing House assistance to industry.

VI THE THEORY OF RATES AND FARES, AND THEIR APPLICATION 81

Rates have origin in "tolls"—Lower limit of rates fixed by cost of movement—"What the traffic will bear" determines maximum rate—The happy medium—"Freight Classification"—Considerations to be allowed for in classing a commodity—Evolution of classification—Cost per mile lessened as distance increases—Equal rates for equal mileage—Exceptional rates—Undue preference—Separation of rates into component parts—Competition and circuitous routes.

VII THE THEORY OF RATES AND FARES, AND THEIR APPLICATION (*contd.*) 98

Passenger fares—Cheap day tickets—Relationship of haulage costs to mileage—The zone principle—Exceptional rates and the reasons for granting them—Owners' risk rates—Their improvement under the new classification—Season tickets, their relation to road competition—Railways offer trader's tickets—Workmen's fares inaugurated by Cheap Trains Act—The principle underlying tourist and excursion fares—The importance of mail traffic—Parcels' post—Miscellaneous traffic by passenger train: milk: perishable traffic—Rates for private sidings—Demurrage at home and abroad—Increases in the level of rates since 1913—Wages in relation to rates—Difficulties of fixing the standard revenue—Hoch-Smith resolution and its effects—Rates in relation to selling price—Factors in the making of freight rate scales.

VIII THE ECONOMICS OF PASSENGER TRAIN OPERATION . 132

Difficulty of allocating costs of passenger and freight traffic—Regular and punctual passenger service essential—Passenger station design—The main line station—Terminals—Track layout—Station time—Time-table designing—Rolling stock roster—Locomotive working schedules—The station-master, a key man—Problems for the operating superintendent—Locomotive power classification—"Equated tonnage" ratings—Small versus powerful locomotives—Signalling in relation to track capacity—The standardization of brakes—Value of speed relative—Safety—Colour and colour position light signals—Automatic train control—Passenger train traffic—The branch line problem—Long non-stop records.

CHAP. PAGE

IX THE ECONOMICS OF FREIGHT TRAIN OPERATION . . 172

Differences between passenger and freight train services—Cartage and delivery—The large terminal—Design and position of benches for loading and unloading—The transhipment shed—A typical wayside freight shed—Size and composition of unloading gangs—Packing of freight—The electric truck—Labelling of goods—The "journey time slip"—Transhipment of traffic—The sorting office—The "road wagon"—Wage bonuses—General economic principles of freight train operation—Efficient working of freight trains—Automatic brakes—Weight in relation to speed—The average train load—Costs of delays—Need for balanced working—Effects of the eight-hour day—The "guard's journal"—Traffic working to and from the ports.

X TRAFFIC CONTROL AND MARSHALLING YARDS . . 206

The despatching system in the United States—Success of the Midland Railway traffic control—Dangers of increased centralization—Control on the Lancashire and Yorkshire—Its use on various sections of the London and North Eastern Railway—Prior to grouping and now—Time boards versus geographical boards in control offices—Advantages of complete control—The problem of freight rolling stock and its distribution—Pros and cons of centralized wagon control—Three main types of marshalling yards—The flat yard and its layout—Design of reception sidings for hump and gravity yards—Essentials for sorting and departure sidings—Braking of wagons on humps in France and the United States—The rail brake in Germany—Statistics of marshalling yards—The yardmaster; an important position—The necessity for speedy wagon movement.

XI THE ECONOMICS OF ELECTRIC TRACTION . . . 230

Difficulty of comparing cost of electric and steam traction—Advantages of electric traction—Lack of water-power a drawback—The earliest electrified lines mainly suburban—London's underground railways—Electrified sections of the L.N.E.R. and L.M.S.R.—The world's largest electrified suburban service: S.R.—The Central Section: late London, Brighton and South Coast—Third rail becomes standard—The old London and South Western, now the Western Section, S.R.—Conversion on the Eastern Section, formerly the South Eastern and Chatham—Variations between steam and electric traction statistics—The importance of the car-mile—The third rail versus the overhead feed.

XII RAILWAY STATISTICS 249

Statistics early required by the Government—Their relation to internal statistics used by the railways—Their value to the nation—Importance of correct choice of statistics—Main sources of railway statistics—The Annual Report—Its approximation to that required by the Railway Companies (Accounts and Returns) Act of 1911—The Statistical Returns—Track and route mileage—Mileage the starting-point of many other figures—Rolling stock statistics—Unsatisfactory tables—The merchandise and mineral table an important one—Maintenance and renewal of way and works tables—

CHAP. PAGE

Maintenance and renewal of rolling stock—Engine-mileage —Traffic revenue—Importance of the ton-mile, a basic figure —Average wagon-load—Net ton-miles per train-engine hour —Net ton-miles per engine-hour—Net ton-miles per route-mile per working day—Gross ton-miles one of the main figures in the United States—Advantages and disadvantages of the train-mile—Train-miles per engine-hour a good key—Wagon-miles—Variation in tare weight causes difficulty—"Internal" statistics—Punctuality among the most important—Great need of special traffic statistics for each district—Coal per engine-mile—Freight station statistics—Cartage figures —Passenger terminals—The reduction of claims—Graphs the best method—Gross ton-miles versus net ton-miles.

XIII ROAD COMPETITION 286

Cheapest and most efficient form of transport best—Advantages of water transport—Air transport, an increasing rival —Most serious competition from the roads—Private cars take traffic from the railways—Motor-buses compete with branch lines—Rail motors—Should railways run motor-bus services?—Problem of the season-ticket holder—Competition of tramways—Motor-lorry competition—Its main advantages—How railways can retain traffic—Road taxation—Efficiency the only real answer to competition—Other countries also have to face the problem.

XIV STATE OWNERSHIP 301

Main characteristic of all public utilities—Benefits derived from State ownership vary with individual cases—Privately owned railways in Great Britain and the United States—State railways on the Continent—The trading instinct, an Anglo-Saxon trait—Government lines open up new countries —Advantages of Government ownership—and its disadvantages—Ownership but not operation avoids many dangers—but has drawbacks.

XV CONCLUSION 312

APPENDIX 322

Schedule of Standard Charges for the Conveyance of General Merchandise by Merchandise Train.

INDEX 325

ECONOMICS OF RAIL TRANSPORT

VOLUME II

CHAPTER I

ECONOMIC FUNCTION OF RAIL TRANSPORT

In the first chapter of the first volume an attempt was made to explain the function of transportation, and it is now time to study the economics of that section of industrial production which deals with the movements of persons and products from one place to another. Taken in its widest sense transportation is the largest and most important industry in all civilized countries. One is apt to regard the industry solely as that of road, rail, and water transport, but in reality telephone, telegraph, wireless, postal services, gas and water distribution are branches of transportation, in addition, of course, to ocean and air transport.

Economics as a science, is dealing with an ever-changing set of conditions, whilst no branch of industry is more dynamic than the transport services themselves. Each phase of the industry is sufficiently important to demand a detailed survey of its economic structure and functions, but in the course of a small work of this nature one must adhere to strict limitations; hence the problems of rail transport are discussed, although they impinge on road and water transport problems at every turn. The most desirable outlook for the student of transportation is, without doubt, that bird's-eye view whereby one surveys all transport services from a co-ordinated aspect, but this study attempts to analyse the problems of rail transport only in Great Britain.

Clay has defined "economics" as the study of business in its social aspect; a definition which includes with exceeding neatness the contrast between the viewpoint of the individual and that of society. The two aspects may on occasion coincide, but in many cases they are diametrically opposed. It is partially by reason of this opposition that the policy of *laissez-faire* is not regarded with the favour that it used to enjoy. One has not to search far for examples of this natural divergence; thus, a boot and shoe manufacturer may make large profits from a business which employs paper and cardboard for building up soles and heels, but it is doubtful whether with a clear conscience this manufacturer could claim that such a policy was in the interests of society. The recent troubles in the coal-mining industry are largely due to the divergence of outlook between the wage-earner, the owner of capital, the coal production and distribution trades, and the different viewpoint of the consumer of coal. The consumer may be regarded legitimately as representing the point of view of society. The million coal-miners doubtless form a large proportion of the producing population of Great Britain, but they are equally consumers; unfortunately, their interests as producers outweigh their interests as consumers.

Our study here is the study of business in its social aspect as applied to railway transport, and this section of the analysis will attempt to deal with the financial structure, the organization, and the methods of charging for services rendered by the railways.

To-day one is, perhaps, too prone to regard rail transport as divided into the functions of transporting passengers and freight, and in truth that is the problem as it presents itself to the railway officer. Passenger traffic is largely regarded as conveying passengers from place to place for pleasure purposes—so many world tours and half-day excursions over distances 200 miles long naturally convey this impression—yet history reminds us that passenger travel for pleasure is a comparatively modern development. Journeys were originally undertaken for purposes of trade: in order to effect the exchange of

products people had to get into personal touch with one another. If one excepts such military expeditions as Hannibal's march to Rome across the Alps, and Napoleon's march on Moscow,—and the former was, after all, a fight for trade supremacy,—mediaeval passenger travel was almost invariably undertaken for trade purposes.

Historians claim that Columbus discovered the Americas whilst engaged in an effort to find a shorter passage to the East Indies so as to open a new trade route for the valuable Eastern spices. The sea route to India round the Cape of Good Hope was discovered by Vasca de Gama in a similar search. In short, the Americas and the sea route to India were discovered by chance,—as one economic geographer has stated—when explorers set out to find a cheaper and safer way of bringing nutmegs to Europe.

The secret of this country's industrial supremacy during the nineteenth century was primarily due to the fact that the greater part of its area was fairly adequately served by water communication before our neighbours on the Continent possessed adequate transport facilities. Britain was fortunate in possessing a long shore line with splendid estuaries from which the distance to the town farthest inland does not greatly exceed 70 miles. Water transport provided a cheap route to much of the country's area and large quantities of bulky articles could be carried by this means at low cost.

The history of early British railways, as explained in Chapter II, Volume I, proves that many of these lines were constructed to carry coal to tidewater, though it was hoped to carry other freight traffic as well. That early railway period coincided with the last two decades of the Industrial Revolution, the name given to the period during which the country population largely forsook agriculture and took to industry. The change over from domestic industry, where people worked in their own homes, to the factory system is closely connected with the construction of the early steam railways.

The effect of railway construction upon the economic development of the country has been partly dealt with

in earlier chapters, but certain theoretical phases must not be passed over without mention. Firstly, it enabled the cost of transporting freight to be reduced because the bulk movement was larger. For instance, the farm cart with a capacity of about 1 ton was at once replaced by the railway wagon to carry 4 tons. Secondly, the effort of haulage was lessened owing to the reduction of friction obtained by the replacement of the road surface by a smooth rail surface. The consequence of this is very important as the same economic law applies to-day. The cheaper the cost of transport, the greater is the distance over which it will pay to carry the goods.

Taking an example, let us suppose that a country town R brewed excellent ale. By road before the railway era the cost of transporting the ale had been so great that it never paid to carry it more than 12 miles ; thus the area over which the ale could compete with other brews of ale was represented by a circle with R as its centre and with a radius of 12 miles and consequently a diameter of 24 miles, roughly 450 square miles. By 1845 R was a railway junction with lines radiating north, south, east, and west. It would be no exaggeration to say that the railway charges were less for 24 miles than the road charges, at that date, for 12 miles. But allowing them to have been equal, the new area over which the ale could compete with other ales was extended to a circle with R as its centre and possessing a radius of 24 miles, a diameter of 48 miles, and an area of 1,810 square miles, or four times as great. The desirability of a low freight rate structure will be self-evident.

For the first time land transport was able to compete on a fairly equal cost basis with water transport if due allowance be made for the advantages of speed. Water transport to-day is still cheaper than rail transport, its permanent way does not wear out, friction is less, and, except in the case of canals, there is no expense of levelling, making cuttings, or constructing tunnels, as is the case in the construction of a railway.

The great advantage which rail transport possesses over water transport is its greater speed, and it was this

advantage which rapidly obtained for the early railways the perishable traffic which had previously gone by canal or coasting vessel. The result was the same as that in the example just mentioned. If a county area S had grown strawberries, they would have been too perishable to send by road to London in large quantities, and equally they would have been damaged by sea transport, but by rail with a fast service S sends its strawberries to London. Hence the betterment of speed, like the reduction in cost, increased the area over which it paid to transport goods.

With the widening of market competition came the concentration of industries in localities where through natural forces the production could be carried on with the minimum expenditure of capital, labour, and the resources of nature. The cotton industry was already centred in Lancashire which possessed climatic advantages and proximity to the Atlantic, but rail transport assisted the specialization of certain processes in certain towns.

Railways built up the woollen industry of the West Riding of Yorkshire, each town concentrating upon the process at which the skill of its workers excelled, and where, through natural advantages such as water supply or cheap power, it was enabled to produce goods at a low price. Although railways were the result of the Industrial Revolution the very fact of their construction created a demand for those very products which, of necessity, could be best produced in factories, rather than in the houses where domestic small scale industry had flourished. The railways created a demand for iron and steel which could not be manufactured without a fair-sized plant, the concentration of workers in towns and cities increased the demand for houses and, consequently, for bricks, metal-work, and wood-work. This concentration within the towns led in its turn to a demand on the railways to transport workers to and from their work, an action and reaction which still persists to-day.

When dealing later in this section of the book with the principles of rates and fares, it will be necessary to study the problem of how the products of one town

compete with the like products of its neighbour, and the desirability of such competition. One aspect should be mentioned at once. The coming of the railway industry which increased the flow of trade, due to lower cost and greater speed, caused a new situation and led to still greater territorial specialization, and the pre-eminence of certain towns for their products, such as Macclesfield for silk, High Wycombe for chairs, and Yarmouth for bloaters, increased so much that large-scale industries sprang up in certain provincial towns. Many of them remain to-day noted for their specialized products, and even export to many foreign countries, but this has only become possible through the reduction of transportation rates both by land and by sea. The greatest social gain is obtained by the production of goods where that can be carried out most cheaply; that is, where natural aids are greatest, as, for instance, climate or the accumulated skill of generations, of which an example might be the mosaic or stone-workers of Italy.

It is the transport system which enables Great Britain to exchange her products made from American cotton with China in return for silk goods. British coal and pottery are exchanged with Argentine beef, Canadian furs, or Baltic timber. This is alone possible with cheap transport rates, and immediately these are increased there will be a tendency to reduce the volume of trade flow, each country will attempt to manufacture for itself, and work will be diverted into industries for which the country is not best suited. Presumably bananas could be grown under glass in England, to take an extreme case, but they would no longer be sold at the rate of three for twopence.

It would be impossible to over-estimate the value of cheap transport facilities, and herein lies the reason why rail transport must be operated at maximum efficiency if the maximum gain is to be reaped by society as a whole.

That the economic development of a country is in direct proportion to its transportation system is probably no exaggeration. Glancing at the position in a few of the Dominions and foreign countries, the truism of this

statement becomes apparent. Canada as a new country depends entirely for its development on rail and water transport; the latter formed the chief means of communication in the early pioneer days. The St. Lawrence in summer formed the route for Montcalm, La Salle, Wolfe, and Frontenac; this led to the Niagara River and along the Great Lakes, but the rich fertile plains of Alberta, Saskatchewan, and Manitoba were undeveloped until the Canadian Pacific Railway pushed through to the Pacific Coast. To-day the Canadian National and the Canadian Pacific systems bind Canada with two great bands of steel with numerous feeding branches, and they open up the country which is probably destined to be the greatest granary of the world. Railways were essential to Canada's development and its mileage of line per 10,000 population is very high, being about 45, with a small traffic density per mile, namely rather less than half that of the United States.

It is sometimes maintained that Canadian railways have been over-developed and the financial weakness of the Grand Trunk Pacific, the Grand Trunk, and the Canadian Northern seemed to bear this out; but the combined system of the Canadian National, under Sir Henry Thornton, is operating with a surplus, and if progress continues this system should prove the greatest asset of the Canadian people.

The United States, with over 250,000 route miles of Class 1 railroads [1] and a population of nearly 110,000,000, is rapidly becoming the greatest industrial country of the world. Yet, without its system of privately owned railways, which, considering the low capital expenditure per mile, are extremely efficient, it could never have hoped to support one quarter of its present population. The American Civil War occurred in the sixties of the last century, and without the unifying influence of the railway network there is little doubt that a very inconvenient hostility between the North and the South would still exist to-day. It would be no exaggeration to claim that the railroads assisted very largely in keeping the States

[1] Those earning a gross annual revenue of $1,000,000.

of North America true to their name of the United States; with its tremendous free trade area, comprising forty-eight States and one Federal District, of 2,973,890 square miles, territorial specialization has taken place to an alarming extent, and, as a result, very powerful aggregations of capital have been formed, such as the Standard Oil, the United Steel Corporation, the Baldwin Locomotive Works, the Ford interest, and the meat packing concerns centred on Chicago. Such concentration would have been impossible without an efficient transportation system. The transport of livestock by rail from the Middle West dealt a heavy blow to livestock production in the Eastern States, but it was the coming of the refrigerator car, to transport the products of the packers from Chicago, Kansas City, and Omaha, which permitted the great specialization of this industry in the Middle West.

The German Railway Company is a highly organized and scientifically operated industrial machine, but here, as in the case of so many Continental countries, railway construction was designed largely with a view to military and strategic needs rather than upon commercial considerations alone. It possesses an extremely able partner, though this partner often takes the form of a strong competitor, in the excellent waterway system based partially upon the large rivers, notably the Rhine and the Elbe. As a State-owned and operated system it was able to subsidize its exporting industries by means of a high level of rates on goods for home consumption.

To turn briefly to the other extreme. China has a teeming population, with abundant natural resources and an ancient civilization, far older than Europe can lay claim to. Yet, it is harassed with continual civil wars, thousands die from starvation or lose all their possessions through floods. A country with perpetual revolution, each district is almost self-governing and entire lack of order and of safety of life are inevitable. China is comparatively undeveloped as regards railways; if plenty exists in one district, the surplus cannot be transported to the district where the shortage exists. There is no railway network, which unifies the country and is the

means by which the strength of a central government is imposed upon the local governors.

The example of India, with its efficient railway system, forms a strong comparison with that of China. The famines which used to ravage India are no longer such formidable terrors, the surplus wealth of other districts is carried to the stricken territory and thousands of lives have thus been saved. The coal trade of India, a comparatively new industry and one only made possible by an efficient railway system, has been successful in obtaining export trade in the East, whilst large iron and steel works have been set up which compete with our own export trade in these products. Electrification of suburban services has commenced with those of the Great Indian Peninsula in the Bombay area. In short, the economic progress of India has proceeded hand in hand with the growth of railway facilities.

Such a brief survey bears out the statement that no country can expect industrial success or welfare without an efficient railway system, although where excellent waterway facilities exist, such as one finds in Holland and Denmark, the railways need not attain the importance that they have attained in such countries as Great Britain or the United States.

Transport by water and rail enters into the cost of nearly all products which one has become accustomed to regard as necessities to-day. To take any example, from the breakfast table for instance. What is the origin of the loaf of bread, what transport services have been required to bring about its arrival ? Let us suppose it is partially made from wheat grown in Alberta. On leaving the farm it is stored in the local elevator, from the wayside station it is carried to an Atlantic port, such as New York or Montreal, or more probably sent by rail to a grain port on the Great Lakes, such as Fort William, where it is graded, cleaned, and stored in the elevator preparatory to being loaded into the lake boat. Transport service number one was its removal from the farm to the railway, transport service number two its removal to Fort William. Transport service number three is its journey by ship to

Liverpool, Hamburg, Rotterdam, Antwerp, or Genoa, let us say, either by transhipment at Montreal into an ocean vessel, or often interspersed with an additional rail haul from Midland (Ontario) to Montreal or Buffalo to New York. From the European Atlantic ports it is sent, often by rail, to the flour mill, which can be regarded as transport service number four. From the mill it may once again be sent by road or rail to the wholesale merchant, who sells it in turn to the retailer, and then it goes to the baker, who delivers it to the consumer. If these latter movements all take place, it will be seen that there are eight transport services in all. It will thus be obvious that the transport services must enter largely into the selling price, in fact they are part of the cost of production, and the nearer the consumer the higher is the per unit cost of movement, because the product will be moving in smaller quantities. One reads constant protests that transport charges often amount to 50 per cent. of the total selling price of an article ; it should hardly be a matter for surprise ; that the products of Alberta are enabled to compete with those of Southern Russia, Australia, and Argentina, is surely a silent witness to the efficiency of the world organization of transportation.

In the case of cement exported to the interior of Africa, the transportation cost may well be over 66 per cent. of the final selling price at its destination ; but more efficient internal transport facilities in Africa would tend to reduce this. There are few commodities in every-day use, the final price of which is not largely made up of services rendered by transport organizations, for the transport service is really only one phase of the productive process. The function of the mining industry is largely the transportation of coal from the coal face to the pit head, and the railway carries it from the pit head to the factory, perhaps only a few miles away.

The examples so far mentioned relate to single commodities, but in many industries it is the function of the transport services, which are largely railways, to bring the numerous component raw materials to one place where they may be made up into the finished product.

In shipbuilding many thousands of different materials, some finished, some raw, must be brought by rail to the shipyard. Many of these have to be transported several times by rail before the finished material is even ready for despatch to the shipyard.

As showing the importance of rail transport for movements within the country, it is of interest that during a recent year over 10,000,000 tons of coal were brought to London by rail, 8,000,000 by sea, and over 30,000 tons by canal. The figures are all the more striking in view of the fact that coal is admirably suited to canal transport. An example from California may be taken as representative of the movement of a seasonal and perishable product, namely cantalupes, a popular breakfast fruit in America when grape fruit is not at its best. Over a comparatively short period 40,000 cars loaded with cantalupes were despatched from California for the other American States. When one considers that the average American covered car has a capacity of about 40 tons, that every car had to be iced every 200 or 300 miles of its journey, and the temperature kept even, it will be abundantly clear that only very efficient organization could cope successfully with such movements. Rail transport of bulk loadings of this kind is likely to be free from road competition for several years yet to come. The railway industry has reason to be proud of such organization.

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CHAPTER II

INTERNAL ORGANIZATION

One must now study the various types of internal organization by which railway efficiency is obtained. Probably there is no subject in all railway economics concerning which views are more strongly contrasted. On one side there is the attitude that whatever be the type of organization it is the limitations of the sphere of responsibility of the persons available to fill the positions which really matter most, in other words the function of any organization scheme is to find the most suitable pigeon-holes for the personnel available.

In contradistinction to this attitude is the one which looks upon the scheme of organization as all-important. The argument runs somewhat as follows. For the successful functioning of any large industrial organization there must be a clear line of responsibility from top to bottom; without such a line there will be endless friction between the higher officers and it will be impossible to lay blame for inefficiency upon any one set of shoulders.

The true position probably lies about midway between these two extremes, since it is quite certain that some definite form of organization must be best suited to any individual line. The second viewpoint is that taken mainly by the theorist who attempts to force practice to mould itself to the paper scheme. But practice is not an obedient child and takes unkindly to a stepfather's ideas; it prefers to mould itself according to environment or tradition, and in that sense the earlier expressed viewpoint is more closely in accord with the true position.

Whatever may be the organization it is patent that the appointment of a man with ambition and a desire for responsibility will tend to enlarge his sphere of influence

when compared with his less forceful colleagues, in which case the balance of power in any organization is somewhat unsettled. Nevertheless, each Railway Company must have an official organization, and it is upon a study of the theoretical foundations on which such an organization must be built that we now enter.

During the post-war period many changes have been made in the organization of railway systems all over the world as a result mainly of the tendency towards consolidation or amalgamation which has been manifested. In the United States the problem of organization has always attracted great attention, a necessity in the case of such wide-flung operating systems as the Pennsylvania, the Union Pacific, the Great Northern, and the Missouri Pacific. The system of holding Companies, where one railway controls at least 51 per cent. of the outstanding stock of others, has, however, somewhat eased the acuteness of the problem, in that the various lines controlled by the New York Central are still regarded as separate operating companies; thus, the Michigan Central Railroad and the Boston and Albany are for all practical purposes separate railways. On the other hand, the Canadian Pacific had a very difficult problem to solve with a main line stretching from St. John, New Brunswick, to Vancouver.

The formation of the Canadian National from the Grand Trunk, the Grand Trunk Pacific, the Intercolonial, and the Canadian Northern systems set Sir Henry Thornton a most difficult organization problem, for the combined system has a mileage of nearly 23,000 route miles. The formation of the German Railway has set an almost equally difficult task to Dr. Ing. Dorpmüller.

In Germany at the end of the war the various State Railway systems were converted into the German State Railway, which itself later became the German State Railway Company, the balance sheet being separated from that of the National Budget. In September, 1924, as a result of the Dawes Plan, the German Railways became a Company under the directorship of a nominee of the Allied Powers. During the time of re-organization

the value of the mark dropped from approximately one shilling to less than one-millionth of a shilling, but has since been restabilized on a gold basis, and twenty marks are once more approximately equal to the pound sterling. The effect of the rise and fall upon the rate structure of the country can be better imagined than described. The French incursion into the Ruhr in 1923 also delayed somewhat the re-organization of the German State Railway system. The German Railway Company is now the biggest single railway operating unit in the world.

In Poland, which country was not in existence as an economic unit prior to the Treaty of Versailles, the problem was especially difficult, as parts of the systems of three different foreign countries had to be co-ordinated into one. With three separate languages, three sets of safety regulations, and two different rail gauges the position could only be described as extremely complex. In Austria, the State Railway system had to be re-organized as that country after the Peace Treaty consisted of a very small territory, having lost areas which now form Czecho-Slovakia, Hungary, and parts of Rumania and Jugo-Slavia.

In France the organization required for rebuilding the devastated regions had to be set up, but otherwise the position there was easier. France through the return of Alsace and Lorraine has developed its industrial production very rapidly since the war, but it is still primarily an agricultural country. Its railway systems had been grouped into five large private Companies long prior to the war, and in addition it possessed a State-owned and operated system which had taken over before 1914 the Ouest Railway. Since the war it has obtained with Alsace and Lorraine the railway which served these two provinces, a line which is to-day operated and owned by the State. Thus there was no need for a consolidation programme in France, and internal organization has changed but little since pre-war days. It is of interest to observe that the lines of division between the French railways do not coincide with routes of heavy traffic flow. This contrasts forcibly with the British situation, where

the line of division often coincides with this flow, as in the case of the London and Birmingham traffic, resulting in strongly competitive services.

In the United States no national policy of consolidation has occurred to necessitate an entirely new internal organization, because the Transportation Act of 1920, upon which our Railways Act of 1921 is largely based, left amalgamations to be voluntarily carried out by the railroads. So far comparatively little has been actually achieved, although the formation of a large Nickel Plate system in the East and the consolidation of the three Hill roads in the North-West, the Great Northern, the Northern Pacific, and the Chicago, Burlington, and Quincy Railroads, would appear to be inevitable in the near future. Recently the New York Central system applied to the Interstate Commerce Commission to consolidate more closely the interests of its controlled lines, such as the Big Four and the Michigan Central, but the Commission, on the comparatively small objection of the non-inclusion of various "short lines," refused the application. In several important cases, however, the internal organization of many American railroads has been altered since the return of the properties to private operation in 1920.

It will thus be seen that this country was not the only one which, at the end of the war, had to alter the internal organization of its railways. Extremely difficult problems have, however, faced at least three out of four of our present grouped systems in Great Britain, and it is doubtful if we have even now found finality in their respective organizations. It is a matter for encouragement, however, that each has set about the task in a different manner, a realization that even in a comparatively small country such as ours conditions are far from being the same in the south as in the north.

On any British railway the shareholders are primarily in charge of railway policy, since it is in their hands to elect the directors. The directors are in their turn responsible for matters of policy, the more important staff appointments, and the financial organization.

Until the recent re-organization of the London, Midland and Scottish Railway the actual executive power in all cases was in the hands of a General Manager, who under the typical British organization of before the war controlled the organization through certain departmental chiefs, such as the Chief Goods Manager, the Superintendent of the Line, the Chief Mechanical Engineer, the Engineer, in reality the Civil Engineer, Chief Permanent Way Engineer, and others. The Secretary was responsible for the registration of the ownership of stocks, shares, and other records. The legal department was headed by the Company's solicitor, who was responsible for all legal and parliamentary work. The Secretary was the only official in many cases who could report straight to the Directors without utilizing the General Manager as intermediary. Thus a typical British railway's organization at the top might have been as in Fig. 1.

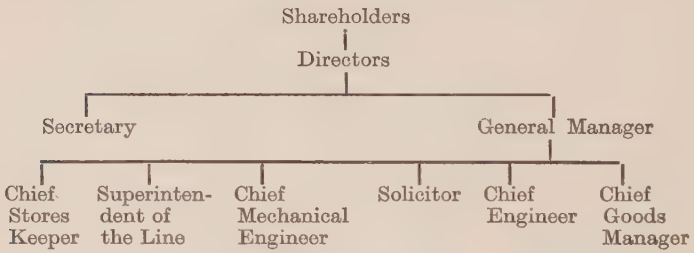

FIG. 1.

Generally speaking under each of these were assistants who were each responsible for territorial divisions, thus taking, as an example, the department of the Superintendent of the Line, whose department was in reality that of operation, one might have found the situation as in Fig. 2.

Many changes in this typical organization have been made since the grouping of the railways, resulting from the Railways Act of 1921, and to-day the Great Western Railway organization is probably the nearest of any to this system. It is hardly a coincidence that the Great Western was the railway least affected by the amalgama-

tion policy and the only one to retain its famous and honoured name. Though every railway organization differs considerably from that of its neighbours, there is nevertheless a clear line of distinction between two divergent policies. These policies result in the formation of what has come to be known as the Departmental and Divisional Systems. The theory lying behind the principle of the Departmental organization is that the technical railway officer should report to a chief who is also technically skilled, thus a local District Operating Superintendent should report to a Divisional Operating

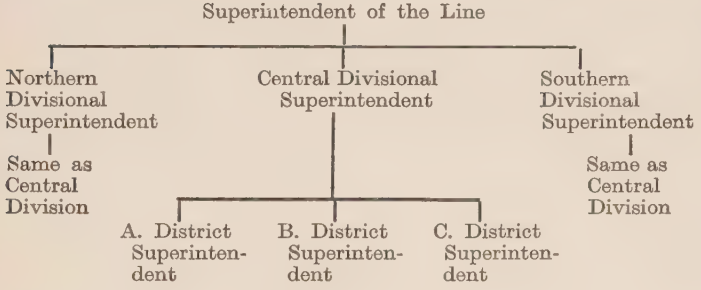

FIG. 2.

Superintendent, and a local District Goods Manager should report to the Divisional Goods Manager. The principle is good, but it leads to great difficulties as the railway systems become larger. Fig. 3 shows that if friction between two departments exists, let us say between two district officers such as the district operating superintendent and the district goods manager, and in case the superior officers back up their local representatives, no decision can be given until the problem for solution reaches the General Manager. He alone has power to decide between the Chief Goods Manager and the Chief Operating Superintendent.

Such a system shows evident weakness and may induce considerable ill-feeling within the organization, also it fails in that by such a system the General Manager must himself have been trained in some one department. Again its main principle breaks down at the top because

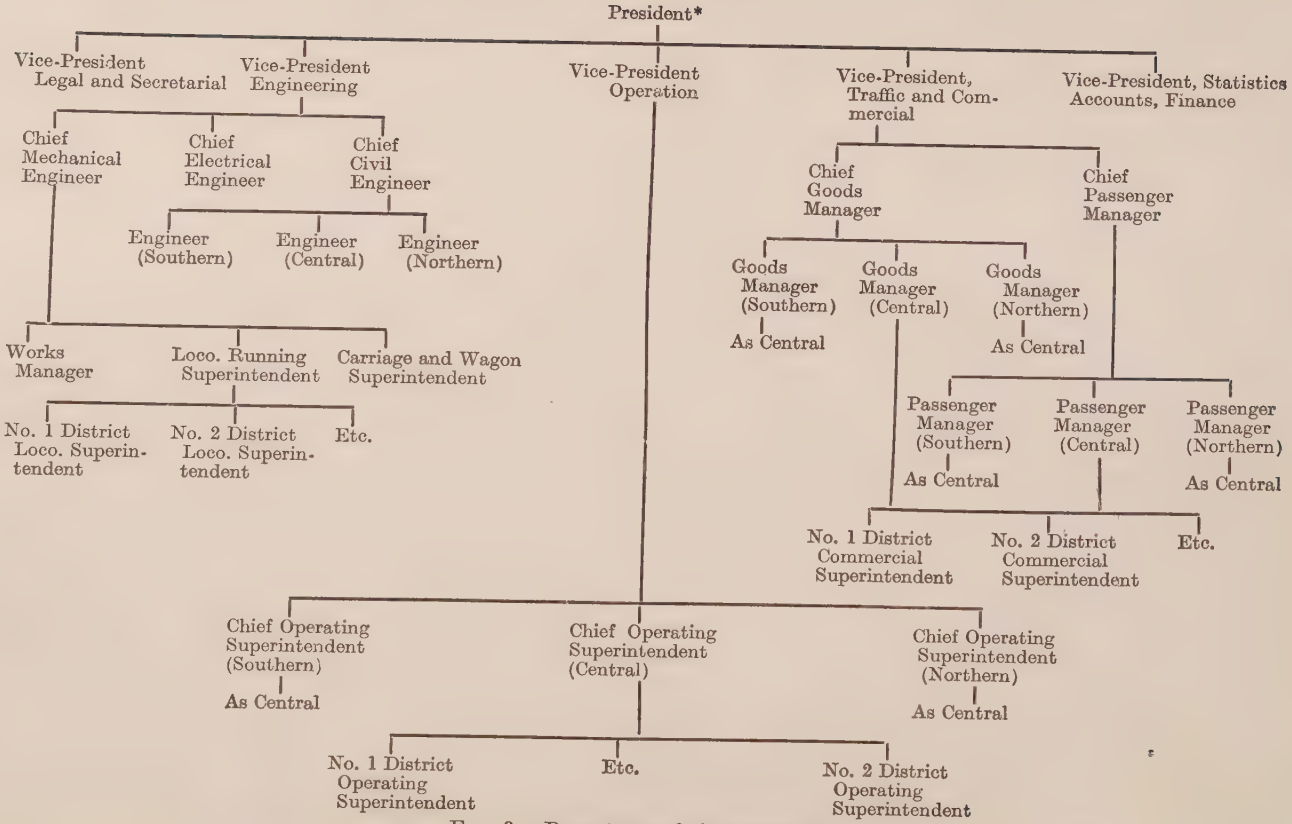

FIG. 3.—Departmental Organization.

* The terms President and Vice-President are alternative to those of General Manager and Assistant General Manager.

the General Manager is not technically trained in all departments.

The Divisional system was designed to obviate these difficulties, and Fig. 4 shows how it attempts to bring this about. The basis is to subdivide responsibility not upon the principle of departmental authority but to rely so far as possible on territorial subdivision. Amongst the advantages of such a system are the prevention of a local interdepartmental dispute reaching very far up the organization, although this is only in part avoided because the divisional officer has not often sufficient engineering qualifications to permit him to undertake the engineering responsibility for his division; it does, however, prevent friction between the operating and commercial departments. Undivided responsibility assists considerably efficient operating, and blame for inefficiency cannot be passed backward and forward between various departments. The Divisional system tends also to give officers a better all-round training, although it often necessitates a technical assistant reporting to a non-technical chief. One of its greatest advantages is the greater choice it gives of officers skilled to undertake the position of General Manager, men in each case who are conversant with the problems of many departments.

It is popularly supposed that the Divisional organization is a more expensive one in the number of higher salaried officers than the Departmental; possibly it may be, but the same argument was used at the beginning of the machine era. The greater efficiency obtained and the effect of decentralization upon personal touch with traders' organizations and public opinion generally in the case of railways traversing large areas of territory, probably offset this greater expense by inducing additional traffic, and, consequently, revenue. In these days of strong competition by road carriers whose strength lies in their power to keep in touch with local opinion, such decentralization as is obtained by a Divisional organization probably just tips the scales in favour of this form of organization.

Those who criticize such an organization often forget that in the position of the stationmaster there exists

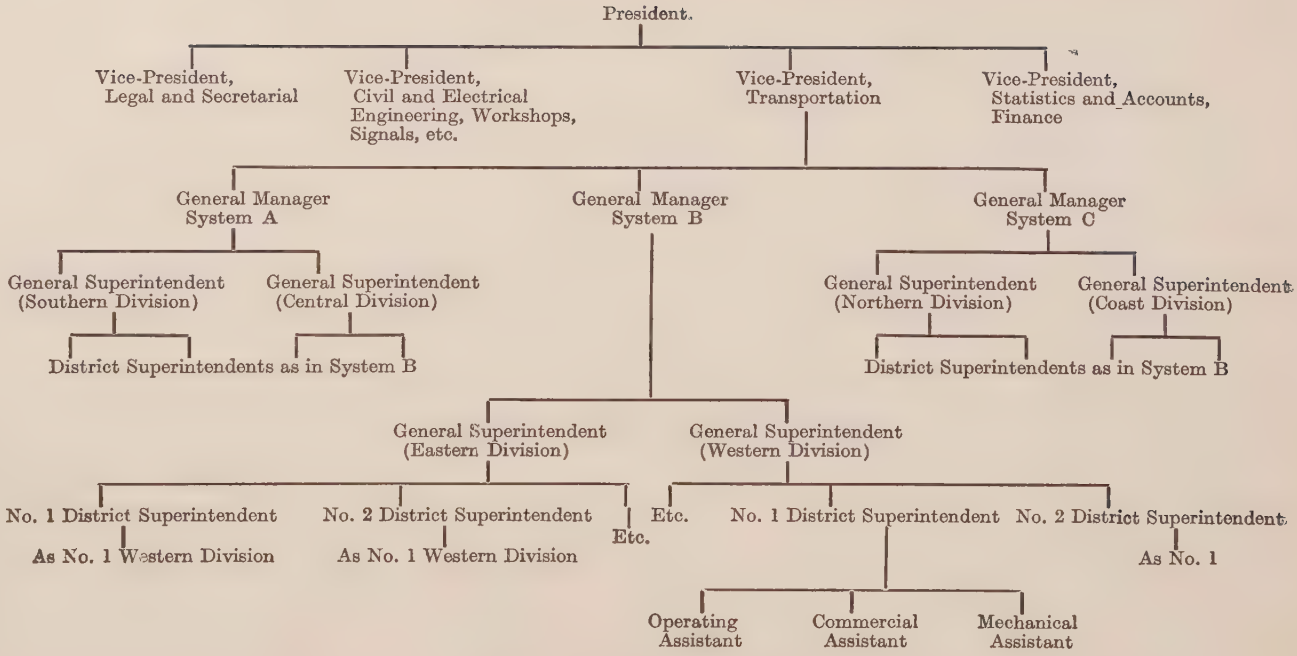

FIG. 4.—Divisional Organization.

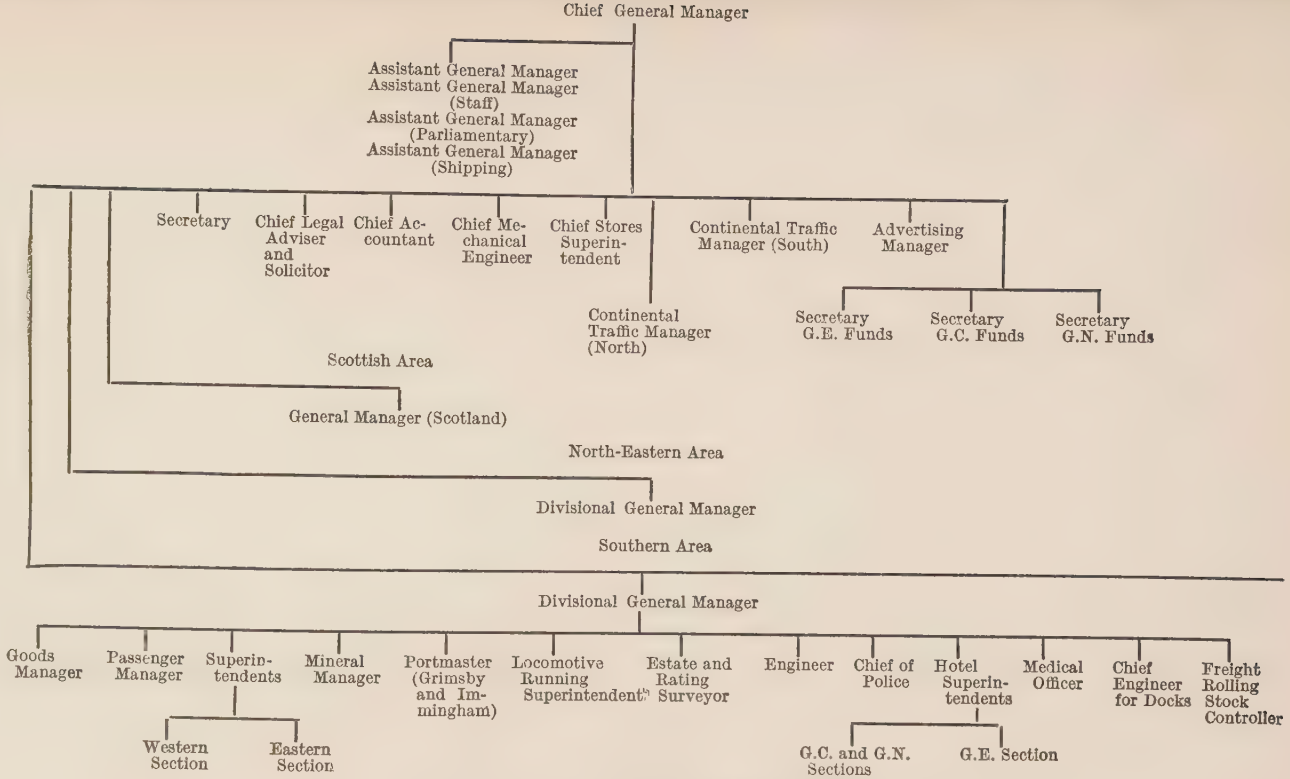

FIG. 5.—L.N.E.R. Organization.

to-day an example of the Divisional organization *in excelsis*. The stationmaster is responsible to the operating officer, the goods and passenger managers. A common complaint against the employment of a Divisional organization in Great Britain is that there would be difficulties with regard to the standardization of labour conditions in the various areas which would be all of a semi-autonomous nature, but such an objection is rather aimed at the application of the system than against the system itself. Every railway General Manager, or President, whichever term may be used, must necessarily be surrounded by a few personal assistants, who should be experts in their way, and in addition he must have certain Assistant General Managers, or Vice-Presidents at Headquarters, responsible for certain branches of railway administration.

In the London, Midland and Scottish organization to-day one finds four Vice-Presidents, but in this case the organization does not follow to any large extent the Divisional system. The four Vice-Presidents have charge respectively of Operation, Goods, Engineering, and Accounts. On the Canadian National one finds Vice-Presidents in charge of the Operation and Construction, Legal, Finance, Colonization, and Purchasing Departments. The first-named Department is separated divisionally into Western, Central, Atlantic, and Grand Trunk Western Regions, as well as the Central Vermont, all of whose working is supervised in each case by a General Manager.

Whether the Divisional or Departmental organization be adopted, the position of the Treasurer, the Secretary, Public Relations, Advertising, and Staff Departments must be at Headquarters. In recent years many important railways have deemed it advisable to set up at Headquarters a small department to deal with economic studies of costs, new construction, or betterment work. On Continental lines this department is often termed the "Studies Department," and is usually manned largely by young engineers; on the Canadian National it is termed definitely the Bureau of Economics; on the London, Mid-

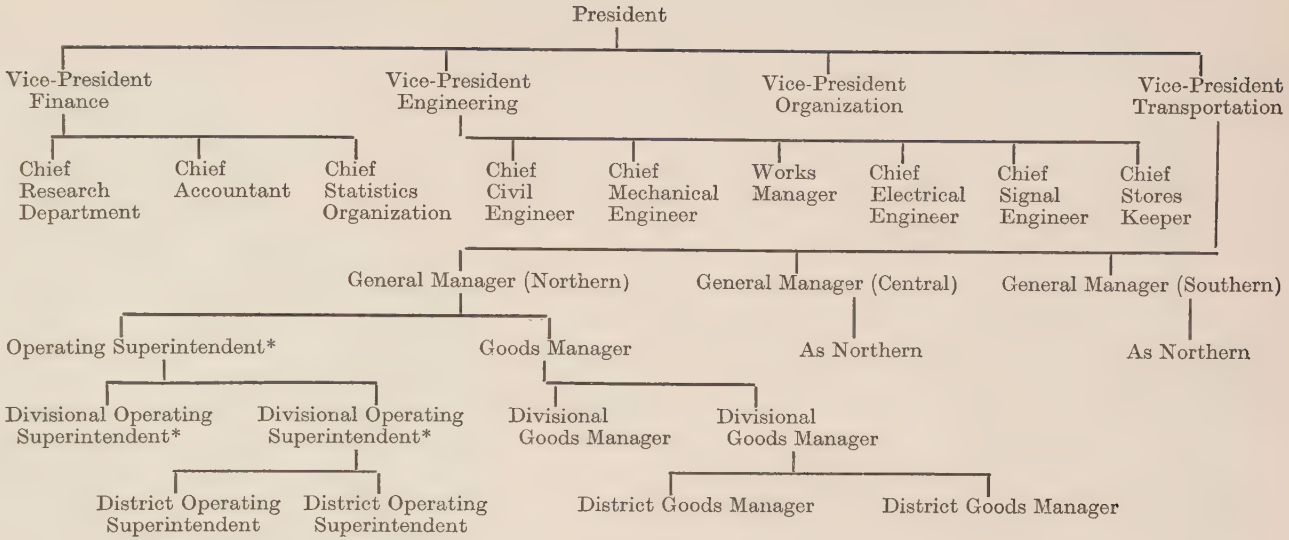

FIG. 6.

* If not a trained engineer to be provided with an Engineering Assistant.

land and Scottish Railway some of the same type of work is undertaken by the Controller of Costs and Statistics.

As regards the present position the London and North Eastern Railway system might be legitimately described as semi-divisional, since it possesses three Areas, each with a General Manager in charge, as is shown by Fig. 5, but within each Area it is mainly departmental in form.

The Southern Railway is mainly departmental in form, as is also the Great Western, whereas the London, Midland and Scottish Railway has evolved an organization of its own which is certainly not divisional but also could hardly be described as departmental. The Pennsylvania, Southern Pacific and Canadian National Railroads have probably adopted the Divisional organization most extensively, due possibly to the wide extent of territory which their respective systems cover. Over small areas a well-designed Departmental system supplies all that is required, but over wide areas it becomes too unwieldy for maximum efficiency.

Such is the theoretical problem of railway organization, and one must now turn to a brief consideration of the most pressing problems of internal organization between the sphere of authority of the various departments. In a country where development came early it is not surprising to find that with the construction of strongly competitive lines greater attention was paid to the growth of traffic than to the reduction of operating expenses. Thus the revenue-producing departments have always possessed greater power on British railways than on those abroad, where the general tendency has been to concentrate attention on the reduction of costs, allowing the automatic development of the country to supply the additional traffic. It is true that until the saturation point of a line be obtained any increase of traffic should tend to reduce the per unit costs of movement, but in Great Britain it has too often been the case that the added traffic has occasioned a proportionate addition to operating costs. To take a concrete example : the Goods Manager obtains an extra traffic of five wagons per day from a certain factory which has previously sent this

traffic by another rail route or by canal. He promises, however, to draw this traffic out from the factory sidings at 5 p.m.; it is found that this may actually necessitate an extra shunting trip from the nearest junction, say 7 miles distant. In practice additional traffic is often obtained by such methods, yet the added cost is at least equal to the additional revenue obtained.

It is worthy of attention that no British railway possesses an appointment equivalent to that of Vice-President of Transportation, who is responsible for co-ordinating the revenue-producing and operating expenditure sides of railway work, and balancing the advantages of the costs of obtaining new traffic against the additional revenue to be derived thereby, although the L.M.S.R. organization approximates somewhat towards such a position.

British railways are almost unique in that they design and manufacture their own locomotives, carriages, and wagons, with the result that their organization must differ essentially from railways in the Dominions and foreign countries. The Chief Mechanical Engineer is, consequently, a much more important official than the Superintendent of Motive Power, for he must design and construct that motive power.

This added responsibility raises many difficulties, for it is often doubted whether a designer should not be left free to design rather than be occupied with much routine work, such as the superintendence of locomotive, carriage, and wagon construction shops, and the everyday running and running repairs. To the solution of this problem the railways have given great attention, but it is doubtful if final success has been achieved. The London and North Eastern and Southern Railways have divided the responsibility between a Chief Mechanical Engineer and a Running Department, the latter having a chief officer in each area, thus leaving the Chief Mechanical Engineer free to concentrate on new designs and experimental work, though remaining in charge of the construction and heavy repair shops through the assistance of Works Managers. The London, Midland and Scottish has adopted a different policy in that the Chief General Superintendent, who is

primarily the chief operating official, if one excludes the Vice-Presidents, possesses the control of the running sheds through certain assistants known as Superintendents of Motive Power. This latter system ensures complete co-ordination between the Operating and Running work, but it places what is often regarded as engineering work under an officer who may not always have been trained as an engineer.

On British railways, however, the modern tendency would appear to be towards the separation of the locomotive running from that of the Chief Mechanical Engineer's Department; the latter is then left free for design work and for the superintendence of the various works. Whether the locomotive running should be handled by a separate department or be placed under the Chief Operating Official would appear to depend entirely on the training adopted by the individual railway for its operating officials. In any case the liabilities to misunderstanding increase proportionately with the number of departments, and the limits of authority between the locomotive running and operating departments are necessarily difficult to define, since a locomotive foreman at a small running shed may be responsible both to the local operating officer and to the local district locomotive superintendent, a representative of the Running Department. Similarly the guard of a train is essentially a representative of the Operating Department, whilst the locomotive crew are representatives of the Locomotive Running Department.

Time alone will show which method proves to be best, but the issue is an important one and is worthy of detailed study by all those responsible for railway organization and efficiency.

The line of division at present between the functions of the Goods Manager and the Operating Superintendent is also too indefinite in many cases, especially as regards the operation of freight station working. Anyone who has had a position of responsibility in a large freight station or depot will realize the difficulties inherent to this problem. The station goods agent will desire to have

control of the locomotive which draws his loads and places his empties, equally the operating officer will desire to have an important say as to the time when he draws his loads to make up his train and to place his empties. With the strong road competition of to-day in this country of short hauls, it seems necessary to give the Goods Manager's representative control in a case of this kind. After all, it is the duty of the operating officer to solve the problem of transporting the traffic handed him at a certain hour as rapidly and cheaply as possible to its destination. But whatever system is adopted it calls for the closest co-operation between the two departments and forms one further argument for the two representatives reporting direct to one regional chief.

Similar difficult problems relate to all branches of railway working, but the cases mentioned above are probably those which have been found to be the most difficult of solution; the respective positions of the Signal and Electrical Engineers are rapidly achieving prominence in view of the increasing importance and greater degree of technical skill required in those departments.

It has been said that one of the objects of any economic study should be to stimulate thought, and with that end in mind the author presents Fig. 6, a railway organization in outline.

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CHAPTER III

BRITISH RAILWAY FINANCE

CAPITAL

In the chapters dealing with the history and growth of the British railways, an explanation has already been given of the causes which led to such high capitalization per route mile. This was partially due to opposition of the land-owners and partly to the needlessly expensive legal procedure necessary before a railway could be constructed. All Railway Companies' Bills, except for works permitted by an order of the Minister of Transport, come under the heading of private Bills before Parliament, and notice of their presentation at the forthcoming session at Westminster must be given by a certain date ; in quite recent years there has been an example when a Railway Company did not give sufficient notice and its Bill could only be accepted finally and the error made good by a vote being taken to permit this mistake being overlooked. The Bill must then be laid on the table of the House of Commons for a certain period, after which it is sponsored by certain members and passes its first reading.

It has to pass two further readings in the House, and if it is of a very contentious nature it is referred to a committee of so many members to be amended or altered to such a form that it will be acceptable to the opposing members. Private Bills are not regarded as party matters in any way, and every member on such occasions votes as he thinks fit, often the lines of division running according to localities. In the early days of railway construction it was often a question of the choice of two or three rival Bills, thus there were no less than seven routes proposed for the line from London to Brighton, and members representing West Sussex and their friends

might well have voted for the route which was to traverse Horsham, whilst those representing East Sussex would have favoured the proposed route through the Tunbridge Wells district. The third is the last reading in the House of Commons, after which the Bill must pass the House of Lords and then receive the Royal Assent. Earlier chapters on the State regulation of railways have stressed the various ways in which the State regulates the safety of operation and the charges made by the railway. The original Act of a railway permits it to raise capital in order to buy its right of way, to build its track and stations, and to purchase locomotives, passenger carriages, and wagons. The capitalization varied enormously with the nature of the country to be traversed, as figures quoted in Chapters II to VI, Vol. I, have already shown.

To answer the apparently simple question of "What is the capital of the British railways to-day?" many hours of research would be required. If the reader refers to the Annual Railway Returns of Great Britain for 1926, compiled by the Ministry of Transport, he will see that there are no less than six kinds of capital and with the large sum at issue the variations between them are important.

Before turning to a study of such figures one must first realize the meaning of the term "capital." Capital is used by economists to describe that form of stored-up wealth which produces an income, though capital may also be the result of personal characteristics, commonly termed ability. The term capitalist is, to-day, not always regarded with favour, yet without capital the present social wealth and welfare could not have been attained. The labourer, if he owns a shovel, does not often regard himself as a small capitalist, yet, in practice, he is one, for without his shovel he would be unable to make use of his labour with which he and his fellows can erect on a vacant plot of land a desirable suburban residence.

Similarly the music-hall artist is a capitalist in two ways; if he is successful at his profession he has prob-

ably put away some savings which his other form of capital, his unusual attainments, either in the form of acrobatic distinction or his india-rubber-like face, have enabled him to obtain. The doctor's skill, the barrister's power of rhetoric and the Hyde Park agitator's hold over his audience are all forms of capital, but in most cases the earnings of these varied forms of capital take the shape of saved-up wealth, which one is accustomed to reckon in terms of currency, of which our British measure is the pound sterling. The saved-up wealth of our ancestors supplied the capital of our many industries, and one of the largest of these is that of the railways, whose total authorized capital is well over £1,250,000,000. This figure does not include the Irish Railways, but includes the many small light railways, tubes, Metropolitan, and the Joint Lines, such as the Cheshire Lines Committee (jointly owned by the London and North Eastern and the London, Midland and Scottish Railways). The authorized capital figure is that which all these Companies have the legal power to raise, though in practice they have only issued rather less than £1,200,000,000.

The issued capital of the biggest British railway, the London, Midland and Scottish, amounted to no less than £407,807,259 at the end of 1926, which included a sum of £1,382,253, being a balance of deductions from nominal capital, which totalled £406,425,006 at that date. In practice, however, when railway shares were in great demand investors were willing to pay premiums in order to obtain the shares with the result that allowance must be made for a balance of Premiums and Discounts. In the case of the London, Midland and Scottish Railway this amounted to no less than £14,615,716, consequently the Capital Receipts from Capital Issued amounted to £422,422,975. This figure of Total Capital Receipts is probably the best one to take if one is asked for the capital of a British railway, since it represents the amount of saved-up wealth which has been used by investors to build up the railway property.

Similar figures for the other three big railways are as follows :

Southern Railway	£149,216,726
Great Western Railway	£168,132,764
London and North Eastern Railway	£322,319,973

The position of British railways is exceptional in that they own as well as the permanent way, stations, rolling stock, and other purely railway assets, a large number of hotels, ships, canals, docks, road motor and horse vehicles, in addition to land and houses. Consequently, a large proportion of the capital expended by the British railways has been on these so-called ancillary services.

Two sets of figures will serve to show the position at a glance (Table I).

TABLE I

	Total Capital Expended upon the Railway.	Total Capital Expended.
S.R.	£136,792,273	£154,203,157
G.W.R.	£146,596,908	£172,143,598
L.M.S.R.	£393,783,989	£444,174,345
L.N.E.R.	£298,659,699	£342,586,348

By comparison with the figures given above of Total Capital Receipts it will be realized that Total Capital Receipts is greatly exceeded by Total Capital Expenditure, the excess being—

£4,986,431 in the case of the S.R.;
£4,010,834 in the case of the G.W.R.;
£21,751,370 in the case of the L.M.S.R.; and
£20,266,375 in the case of the L.N.E.R.

This situation is a fine tribute to the conservative finance of the British railways, for it has resulted from the policy of putting back into the business, for productive purposes, in past years an important percentage of the profits of the industry. It is true that the present position has only come about as a result of the policy of grouping, when the exchange of shares was based primarily upon earning power. Sir William Acworth included the following figures in an article contributed

to the *Economic Journal* of March, 1923, and they are worthy of careful study and detailed thought.

"The following table (Table II) shows how the consolidation scheme has dealt with the securities of the four constituent companies in the Southern group.

TABLE II

	Capital on which Interest or Dividends were payable as at December 31, 1921.	Nominal Value of Holdings in New Company given in Exchange to the Four Companies respectively.
L. and S.W. . . .	£59,045,148	£52,740,374
L.B. and S.C. . . .	29,700,658	35,584,393
S.E.R.	33,462,718	32,165,107
L., C. and D. . . .	30,386,473	24,356,923
	£152,594,997	£144,846,797

"The position of the other three groups may be summarized as follows (Table III) :—

"Total capital on which interest or dividend was payable :—

TABLE III

	Jan. 1, 1922.	Jan. 1, 1923.
Great Western group . .	£147,256,336	£136,242,555
London, Midland and Scottish group	455,292,862	335,297,585
London and N.E. group .	342,037,058	370,000,000

In only one case, that of the London and North Eastern Railway, does the Nominal Capital exceed even that of capital expenditure.

With complaints heard on all sides of the low returns on capital being paid by British railways, it is surprising to find that if one studies the Average Rates of Interest or Dividend paid per cent. of receipts from Capital

Issued one finds that the average rate paid for 1913 was not materially different from that of 1925, although one must remember that much of the dividend payments was made from reserves in 1925, and not in reality earned, whilst as mentioned above much capital which had little earning power in 1913 has since been eliminated.

The figures, however, are striking (Table IV).

TABLE IV

	1913.	1925.	
S.R.	4·07	4·35	Average Rates of Interest or Dividend paid per cent. of Receipts from Capital Issued.
G.W.R.	4·43	4·62	
L.M.S.R.	4·45	4·32	
L.N.E.R.	4·09	4·16	

There are many different classes of railway capital, but they are of two main kinds. Firstly, there are shares which denote money subscribed, and represent a share of the ownership of the concern ; larger blocks of shares are sometimes known as stocks. Railway stock, it is not always realized, has the advantage of being transferred in any amount, the only restriction being that for convenience sake and expense of handling a pound cannot be split into fractions. Thus, the railway shareholder is very largely the small investor, and railway shares with their steadier rate of return are better suited than most industrial shares for investment by those employed in the industry, though preference or guaranteed shares are stock better suited for this purpose than ordinary shares.

The second large class of capital is the debenture, comparable to the bonds of American railroads,[1] in reality money subscribed to the Company by the debenture holder, that is to say, the debenture holder is a creditor of the Company, which itself is, in fact, a large number of shareholders. As a result of this position, should the Company go into bankruptcy, the creditors, namely the debenture and bondholders, possess a prior claim on the assets.

[1] There is nothing, however, quite comparable to American railroad mortgage bond system.

There are naturally various divisions of debenture holders, the first debenture holders possessing the first claim, the second debenture holders the second claim, and so forth. Similarly each year the debenture holders have first claim on the profits, if there be any, on the year's working. If they fail to get any interest paid upon the capital they have loaned, they have the right to appoint a receiver for the property, if they think fit, thus replacing the management set up by the shareholders by putting in a management of their own choice.

It will be realized that their capital is comparatively safe, and, in view of this, they are content to receive a low rate of interest. The question may occur as to why interest payments are necessary, yet it is clear that the individual who has either received saved-up wealth in the form of inheritance or has saved up that wealth himself will desire to make that capital productive. He might buy land upon which to grow apples in British Columbia, he might invest in a tea plantation in Ceylon or a rubber plantation in the Malay States, or he might lend it to a Railway Company to enable the latter to construct a new piece of line or to buy steamers to start a cross-Channel service, but in any of these cases he expects to obtain some return on his investment. The return is roughly proportionate to the risks he takes of losing his capital, or of balancing lean years with good years. Where the industries are highly speculative, such as mining ventures, or rubber or tea plantations, the yields of return will be high, at any rate over short periods.

They may be compared to the returns on the other factors of production, labour and land. In the former the return takes the shape of wages, whilst the latter is termed rent. Just as the yield is high with speculative shares, so the wages of labour for dangerous work are normally high also. The return on land, namely rent, is an economic study in itself and one which is too complicated to enter upon in this connection because in a highly-developed country, such as Great Britain, there

is little land the productivity of which has not been greatly increased by the application of considerable capital. The problem of land values is not intimately connected with our present study, although in the United States this problem is closely interrelated, due to the fact that railway charges are designed to yield a percentage return on the value of the railroads according to the Transportation Act of 1920. The task of valuing the railroads has been the subject of continuous study since the passing of the La Follette Act in 1913, but in spite of large expenditure by the railroads [1] and the community [2] finality is still far from realization. Fortunately our own Railways Act of 1921 avoided this pitfall and based the future level of charges upon previous earnings, a position to be studied in a later chapter.

After the required interest has been paid upon the Loans and Debenture Stock, the balance of profit is available for distribution to the remaining stock and share holders. There continues to be a definite order in their precedence.

To make the situation clear it will probably be desirable to take a specific case, and one might choose the London and North Eastern Railway. The next stock to receive payments, in that case, is the 4 per cent. First Guaranteed Stock, after which comes the 4 per cent. Second Guaranteed Stock. Next come the three Preference stocks, the first two, namely the 4 per cent. First Preference, and the 5 per cent. Preference Stock, Redeemable 1955, ranking *pari passu* for dividend purposes; thirdly comes the 4 per cent. Second Preference Stock. After interest requirements have been fulfilled on all these stocks, which carry a fixed interest rate, the balance is available for distribution to the holders of the 5 per cent. Preferred Ordinary Stock, and finally to the holders of the Deferred Ordinary Stock. It will thus be seen that there are no less than seven sorts of stock of this one Company after excluding Loans and Debentures.

Considerable discussion has arisen since the grouping

[1] Cost to railroads estimated at £20,000,000.
[2] Cost to the Government at £6,000,000.

concerning the desirability of splitting ordinary railway shares into preferred and deferred. The London, Midland and Scottish, and the Great Western Railways have successfully stood out against pressure to split their shares, but the other two Companies have found themselves saddled with more than one set of ordinary shares : the Southern commenced its life with no less than four —namely, the Preferred, the Deferred, and A and B— but the last three have since been consolidated.

The argument in favour of splitting the shares rests mainly on dividing more accurately the proportion of risk and steady security, thus catering for two kinds of investors. These advantages are, at any rate in the case of railway shares, offset by the greater saleability, and consequently, truer level of price obtained by a wider market in the case of a consolidated stock. It is doubtful if there is room for an element of speculation in railway shares whose values are ultimately dependent on the success of a Tribunal to fix the level of rates and fares accurately enough to bring in a predetermined net revenue. The speculative element is not socially desirable in public utility finance, and the Board policies of the London, Midland and Scottish, and the Great Western Railways are highly to be commended for taking a strong stand against the splitting of ordinary shares.

Owing to the essential difference between the debentures and stocks care must be taken to see that they exist in suitable proportion. Any preponderance of debentures to stocks and shares will create insecurity for the holders of the former. Likewise the higher the proportion of capital carrying fixed interest rates the more will variations of traffic revenue affect the rate of interest paid on the remaining shares.

Compared with many American railroads the four British Companies are fortunate in not possessing a financial structure made top-heavy by reason of heavy fixed charges, namely the interest on bonds and debentures. Thus on the London and North Eastern Railway the total capital created of £368,578,221 (1926), consists of £259,413,404 shares and stocks, and only £109,164,817

Loans and Debenture Stock, or roughly 30 per cent., though it must be admitted that a large proportion of the £259,413,404 consists of fixed interest-bearing securities.

Turning to a consideration of the characteristics of railway capital, it is clear that although the stocks and shares themselves may be sold at will on the Stock Exchange, the investment itself cannot easily be moved, it is immobile and largely irrecoverable. If a railway is once built and fails to pay its way, the owners cannot say, "Let us shut up shop, and move to the next corner," like the man who sells oranges on a barrow. Even the road operator can move his bus service from route to route according to the variation in market days in the different towns or in accordance with the rise or fall of traffic flow during the different hours of the day. Firstly, like the tramway, the railway investment is fixed and not easily adaptable for any other purpose. The old route of the Delaware, Lackawanna, and Western Railroad for some miles in Pennsylvania is now used as a highway parallel to the new and better graded tracks, but such a case is rare. Many road engineers without doubt cast envious eyes upon railway main lines, but it is socially preferable that freight and passenger traffic should be carried by a means of transport entailing the lowest cost per unit.

The second outstanding feature of railway capital is its very large amount compared with the total turnover of revenue, and a railway must be fully equipped before practically any return at all can be obtained. Before the war period it required nearly ten years' receipts to equal the capital of the railways; since the war the purchasing power of money has altered and thus charges are reflected in expenses and receipts altering this proportion since the amount of capital raised has naturally altered comparatively little; even so, to-day the comparison with a typical industry, such as a small shop, is very striking, for in the latter case the turnover per annum is frequently equal to several times the capital of the business.

Thirdly, there is a very small degree of profit in each unit of turnover, which fact has a far-reaching effect economically upon railway operation. It explains why it is difficult for railways to reduce expenditure proportionately to reduction in revenue, and it also explains in part the theory upon which freight rates are based. A small drop in price will sometimes cause a great increase in demand; in such cases demand is regarded as elastic. Especially is this true of many luxuries, such as excursions by rail: in other cases, it will make little difference to the demand, that is, demand will be inelastic; such

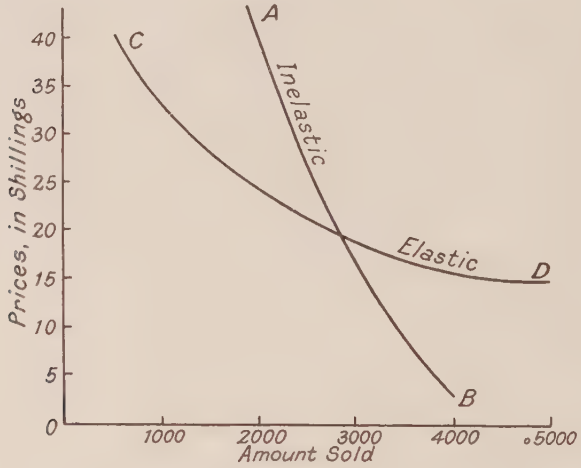

Fig. 7.—Curves showing Elasticity and Inelasticity of Demand.

will be found to be the case with many necessities of life—bread, salt, meat, and hair-cutting. Fig. 7, showing curves representative of demand, will illustrate the position more clearly.

A small drop in prices will cause a large increase in demand in the case of CD and a comparatively small increase in the case of AB. AB might represent the demand for salt and CD that for tickets for greyhound racing.

Since the capital of a railway is so irretrievably sunk, the effect of a new competing line which indulges in cut-throat competition is very serious. In practice after a

period of reduced fares and rates, increased facilities and services out of all proportion to the traffic offering, both railways come to an agreement which very often results finally in amalgamation. A good example in Great Britain was that of the London, Chatham and Dover, and the South Eastern Railways, which together formed the South Eastern and Chatham Railways Managing Committee. However much legislators may urge competition upon railways, there is only one logical and unavoidable conclusion in the long-run to cut-throat competition, namely some form of voluntary or forced agreement.

A fourth characteristic of railway capital is that the return upon it is largely regulated by the State, or representatives of national bodies appointed by it. Imagine the outcry if railways paid dividends of 15 per cent. like many business firms. Immediately, a reduction of at least 33 per cent. in passenger fares would be demanded, a pre-war level of freight rates would be the traders' request, and from the employees at least a 10 per cent. rise in hourly wage rates. In practice, if not in theory, the return on railway capital is regulated by Governmental bodies, in this country by the Railway Rates Tribunal and National Wages Board. From figures quoted previously in this chapter, it will be realized that the return on railway capital is not greatly different from that of British Government stocks, ranging from Consols carrying $2\frac{1}{2}$ per cent. to 5 per cent. on War Loan. Recent years have been financially disappointing since British railway revenue is bound up with British business prosperity, and until the latter improves and is freed from internal dissension, railway revenues cannot improve, and without that much hoped for improvement the railways cannot raise further capital to increase their productive capacity at sufficiently low rates to make such programmes financially and economically desirable. There is here evidence of a vicious circle.

In conclusion one may say that the spread of ownership of British railway capital is very wide, from the very rich to the very poor ; often it is the only type of investment

held. Being a trustee stock [1] it is owned largely by hospitals, pensions funds, widows, and charitable institutions, whilst recently special efforts have been made to induce the railways' own staff to take up new issues of stock. Whether such a policy is socially desirable is too large a subject for debate here, but whatever may be its disadvantages, a financial interest, however small, in the Company's affairs should be of advantage, though such holding should only be in guaranteed and preference stocks.

Revenue

The revenue receipts of the four British railways are noteworthy for the large percentage of the total due to passenger traffic and for the considerable amount of non-railway revenue, namely, that derived from such ancillary services as steamers, docks, hotels, and road motors. In this latter respect they are almost unique, for American and Continental railways have always adopted the policy of keeping strictly to railway operation alone, though exceptions do occur, notably in the case of the Canadian Pacific Railway with its magnificent ocean liners and chain of hotels. Its great rival, the Canadian National Railway, also owns hotels, and manages State-owned steamers, whilst the Nord Railway of France, through a subsidiary, runs two boats between Dover and Calais; but such cases are rare, and in the United States so opposite is the policy that even large terminal stations are run by a separate Company. Recently, however, the German Railway has opened a large hotel, and many foreign railways have commenced to run motor services.

Let us deal with these extraneous services run by the British railways first. The railways have very often

[1] The Trustee Act lays down that the debenture, guaranteed, and preference stocks of a British Railway Company which has, during each of the past 10 years, a dividend of not less than 3 per cent. on its ordinary stock shall be trustee securities. But according to the Rules of the Supreme Court, trustee status is also permitted to any fixed interest stocks of a British Railway which has paid any dividend on its ordinary stock during each of the previous ten years.

been attacked for indulging in the operation of these so-called frills to pure railway work, but there is a great deal to be said for most, if not all, of the extra departments. The most usual form of complaint, often by shareholders, is that such and such a steamship or omnibus service is run at a loss. The complaint is natural, and if a service is run at a loss it certainly ought to be shut down and the loss eliminated. But the economic problem is by no means as simple as it looks. Even if an actual steamer service is run at a loss, it may bring sufficient traffic to the railway at one end to help the latter to cover its fixed charges. Again, a steamer service might attract persons to some seaside resort which they would not otherwise visit. The steamer service itself may be run at a loss, but the railway service may gain more than the steamer service loses. The same consideration is also true of branch lines, which may not pay in themselves, but which pay when acting as feeders to the main line.

Canals are the most important form of ancillary enterprise which does not pay its way, the reason for this being largely historical in that the railway was forced to buy up its predecessor, the canal, in order to get its own Bill through Parliament. Taken as a whole the steamship services of the four groups earned a handsome net revenue during 1925, the last normal year for which figures are available, as also did docks, and hotels, under which heading are included restaurant cars and refreshment rooms. In the case of the two northern lines passenger road vehicle services were run at a loss, but may have proved their worth to the railways as feeders. It has been often remarked that where a railway motor service has been run at a loss a private venture has afterwards succeeded, but such a result is not to be wondered at, since the railway services suffer from the strict adherence to National agreements with regard to hours and conditions of work, whereas the non-railway bus owner has no similar restrictions upon his services. When dealing with road competition we shall inquire further into this question. In this chapter dealing with revenue all that we need note is that important gross receipts are

obtained from these ancillary services. For all the railways of Great Britain the gross receipts and expenditure from these various ancillary services in 1925 are given in Table V.

TABLE V

	Gross Receipts.	Expenditure.
	£	£
Passenger road vehicles . . .	207,340	230,151
Steamboats	4,312,313	3,938,335
Canals	188,000	299,776
Docks, Harbours and Wharves .	6,867,551	6,048,466
Hotels, Refreshment Rooms and Cars	6,450,651	5,409,709
Other separate businesses . . .	65,631	58,065
Total	£18,091,486	£15,984,502

Small compared to the gross receipts and expenditure for railway working proper for the same year, it is nevertheless an important percentage.

Railway Gross Receipts.	Railway Expenditure.
£199,652,875	£165,024,012

But whilst the inclusion of the Underground systems and other railways not included in the grouping hardly affects the figures relating to ancillary services, it does materially affect the railway working figures, hence the total railway working figure for the four groups together would be a fairer one to take.

Four Groups Gross Receipts.	Four Groups Expenditure.
£192,580,187	£160,435,858

Besides receipts from railway working and ancillary services each of the Companies obtains certain miscellaneous receipts from land rents and interest on investments; unfortunately the latter after the heavy withdrawals from reserves during 1925 and 1926 will be smaller for some years until reserves are again built up. These miscellaneous receipts in 1925 averaged rather less than £2,000,000 per Company.

Railway receipts are divided into those derived from passenger train traffic and those derived from freight train traffic. In the case of the Underground group nearly all revenue is derived from the former, and even in the four large British groups which are the subject of this book the proportion due to passenger traffic is much greater than in the United States, Canada, France, or other foreign countries, or Dominions. It is somewhat difficult to explain exactly why this should have been so, but it is a noteworthy feature of British railway history from 1830 onwards. As a whole the country is thickly populated, but so also is Belgium, as are certain areas of Germany, France, and the United States.[1] It is possible that the explanation lies in the fact that British railways were built purely for financial and commercial ends, not to develop new country or for strategic reasons; thus our railway network is close where population is great and light where population is sparse, as in the Highlands of Scotland, Mid-Wales, and parts of Devon and Yorkshire. For whatever cause the percentages in Table VI show how important is passenger revenue to our four great lines, a feature which is likely to play an interesting part in the definite rivalry between road and rail traffic.

Whilst receipts may be divided into these two divisions, no similar division can be found on the expenditure side. Undoubtedly, such would be desirable, but is it possible without making so many assumptions as to make the result so comparatively useless that it does not warrant the cost and time of getting out such figures? This question has been the subject of study in recent years

[1] According to tables arranged by the Railway Economics Bureau, Washington, covering the year 1916, since when no great changes have been made in railway mileage construction, the United Kingdom possessed about 5 miles per 10,000 of population

United States	„	„	25	„	„	„	„
France	„	„	12	„	„	„	„
India	„	„	1	„	„	„	„
Belgium	„	„	7	„	„	„	„
Germany	„	„	8	„	„	„	„

TABLE VI

	1925.	
	Gross Receipts from Passenger Train Traffic.	Gross Receipts from Freight Train Traffic.
	Per cent.	Per cent.
G.W.R.	45·08	54·92
L.M.S.R.	42·46	57·54
L.N.E.R.	39·14	60·86
S.R.	73·89	26·11

in many countries such as our own, India and the United States, by those responsible for the Government regulation of railways. In the last named actual attempts have been made. During 1927 it was publicly stated that passenger traffic was being run at a definite loss, the figures given showing that passenger traffic absorbed 28 per cent. of the total operating expenses and produced only 20 per cent. of operating revenue in 1926. Excluding mail and express revenue passenger service produced only 16 per cent. of total revenue, whilst about 25 per cent. of maintenance of way and rolling stock was estimated as due to passenger train service. If such figures cannot be obtained with accuracy it will be realized that there is no method of knowing whether passenger fares are being subsidized by the charges on freight traffic or not. This is a very serious situation, but by taking some of the divisions of expenditure separately the difficulties become at once apparent.

Thus, under the heading of Maintenance and Renewal of Way and Works, if a line is relayed, to what extent should the cost be put down to passenger traffic ? To be accurate in this case one would have to know the relative effect, upon wear and tear of the rails, of speed and weight. Does a main line express weighing 400 tons, travelling at 70 miles per hour, cause more wear and tear than a freight train with possibly a heavier weight per axle ? It will be seen that the difficulty is great. Under the heading of Maintenance and Renewal of Roll-

ing Stock, ought one to debit to the cost of freight service the repairs to a branch line freight locomotive utilized for 39 per cent. of its time in passenger work? Under the heading of Locomotive Running Expenses, ought one to make any allowance for the cost of a freight locomotive doing pilot work at a passenger station between its booked trips? Or if a freight locomotive is required for a special excursion booking or for taking soldiers to manœuvres what allowance should be made? Again there is great difficulty. Under Traffic Expenses, is one to divide the pay of a signalman in proportion to the number of times he passes through his section passenger trains and freight trains? It might be possible to do so, but the cost would be enormous and out of all proportion to gain achieved. Under the heading of General Charges, how would one divide taxes, local rates, Parliamentary costs, according to ton-miles and passenger-miles? Or according to revenue?

It is evident that an accurately given definition of the proportion of expenses between the two services of freight and passenger is almost an impossibility. All one knows exactly is the direct cost of running an extra train, and an estimated allowance is made for indirect charges. After all, if the revenue earned by the extra train covers the added cost of the train one is probably on the right side, as anything over will help towards defraying the fixed charges. With so large a proportion of fixed charges it is a golden rule of railway economics to obtain as much as possible out of the rolling stock and equipment, for this very reason.

Expenditure

Turning next to the study of expenditure, two main features are immediately evident. Firstly, the fact that a railway must be completely equipped before it can earn a penny. It must possess rolling stock, and be passed by the Board of Trade as equipped with all safety devices and the stations completed. One might, perhaps, qualify this slightly in two respects. Some of the early railways were opened for part of their length before the

whole mileage was open. For instance, coaches ran from Basingstoke to Winchester, joining the two ends of the London and Southampton Railway, until the section with the largest engineering works was completed. It is also true that temporary structures could be used as stations until traffic had grown sufficiently to warrant permanent structures. But it is true as a generalization that a railway must be complete before it starts to earn any revenue.

The second characteristic of railway expenditure is that so large a proportion of it is fixed, that is to say, that however the flow of traffic may vary from time to time, the expenditure cannot be reduced in proportion. This is extremely important to realize, and is the secret of the difficulties which face British railway managements to-day. The coal handled by our railways has fallen in volume very considerably, chiefly in South Wales, and on the north-east coast, from which fields much of the coal is exported. But it is quite out of the question to reduce expenditure involved in handling the coal export trade. Let us suppose that there is a double line of rails down a South Wales valley, leading from ten collieries to the coal-shipping port of Barry. In 1923, a boom year for coal export, the line handled thirty coal trains a day. It now handles fifteen. The revenue is halved, but the monthly expenditure is hardly affected. The locomotive costs are down a little, it may be possible to close one or even two signal-boxes for some hours a day and to lengthen the sections, and it might be possible to dispense with a guard or two. The line must be maintained just as well as before, the reduction of wear and tear on the rails is negligible. The reduction of staff is highly undesirable at the present time with so many unemployed, and it is often false economy to part with excellent employees who are trained to their work, such as goods guards, signalmen, and locomotive employees, a policy which no one likes, and one which is socially disagreeable and inadvisable.

Expenses are usually separated into two divisions: fixed, or overhead, and variable. The former are those

which are not alterable to any great extent with reduction or increases in revenue. It is impossible to draw a definite line between fixed and variable expenditure, though many have attempted to do this. Such a fixed line to-day seems entirely out of date and takes little notice of modern developments. Amongst fixed expenses are always included such expenditure as interest on funded debt, namely, debentures and loans. This is a first charge on all net revenue ; if it is not available the bond holders and mortgagors can, in the long run, seize the property. Insurance of property against fire, and other risks, is obviously fixed and cannot vary with traffic. Maintenance and Renewal of Way and Works, which accounts for about 12 per cent. of total annual traffic receipts on a British railway, is very largely a fixed expenditure ; it would be extremely unwise to allow the maintenance of signals, permanent way, telegraph lines, and stations, to be let down if the traffic dropped by 5 per cent. It is true that one can slow up the painting programme and possibly make sleepers and signal-posts last a few more months, but it is often false economy and has to be made up at a later date. It should be borne in mind that it is the economic and social duty of all businesses wherever possible to keep employment as even as possible, thus making some attempt to balance trade booms and depressions which are the greatest curse of the modern industrial state.

In America the problem is made far more difficult by heavy climatic conditions, but variations in employment are surprising to one accustomed to British conditions. Thus the number of employees of Class 1 railways in the United States varied during the year April, 1926, to April, 1927, from 1,866,115 in October to 1,720,520 in February.

Maintenance and renewal of rolling stock accounts for about 15 per cent. or 16 per cent. of total annual traffic receipts on our British lines. Once again it is a type of expenditure which is largely fixed and cannot be varied at will in accordance with variations in traffic over short periods of time. Over a long period of time it might be possible to save somewhat, perhaps, in types of rolling

stock which have become obsolete, or where certain traffic has possibly become largely a road traffic. But in such cases usually a new type of traffic has to be handled, in which case obsolete wagons must be replaced probably by motor trucks. Also conditions of trade vary over long periods of time, and by the time money has been saved the trade depression will have been passed. It is, therefore, impossible in times of trade depression to reduce expenditure under this head, in proportion to the reduction in traffic.

Locomotive running expenses account for about 20 to 21 per cent. of annual traffic receipts and to a certain extent can be reduced in accordance with a reduction of traffic, especially in such cases as where coal trade falls. There is, however, an opposite tendency at work as regards this kind of expenditure. Unlike a somewhat reduced coal traffic, which may be offset by running fewer coal trains, though even here extra marshalling may counteract this saving, it is impossible to cut trains out if, say, 5 per cent. less people travel. It may be possible to make the trains one or two carriages shorter, and this saving in carriages may delay renewals for some months, but the total savings will not be large until whole trains can be cut off. The most recent tendency has been rather to increase the number of trains, thereby offering better service in order to attract traffic, a policy which few will decry, and, therefore, one comes to the conclusion that locomotive running expenses, though more variable than other items of expenditure previously mentioned, cannot be reduced in proportion to reduction of traffic.

Traffic expenses, which include those of the operating staff, are closely connected with locomotive running expenses and are equivalent to about 29 per cent. of traffic receipts. It will be seen, therefore, that if one adds locomotive running expenses and traffic expenses together, 50 per cent. of traffic receipts is accounted for. Traffic expenses are the most variable type of railway expense. If traffic falls off, it is here that reduction of expenditure must be attempted, to offset the reduction of revenue. But even here the position is not easy. If

passenger traffic and freight traffic from one station fall off by 5 per cent., it is all very well to attempt to reduce the staff by 5 per cent., but if there is not a staff of twenty it is a difficult matter. A reduction of one man from a staff of five is a large percentage, namely 20 per cent., and even if one does that expenses are not saved proportionately. Take the case of a sitting-room in a house with two people sitting over the fire ; if two friends come in the same fire does for the four, though possibly one breaks up the lump of coal to brighten things. The same is true of all office and station economy : the overhead costs of such a thing as fire, a pen, ink, and chairs, do not increase proportionately with the increase of staff. Thus, though traffic expenses may be said to be variable it is hard to vary them in relation to changes in the volume of traffic if one rules out changes in rates of pay, which form another problem altogether, as does also the question whether it is socially better to reduce or increase the number employed or vary the wages. The whole theory of wages is one of tremendous complications, as will be evident if one asks twenty different people what a wage rate should be based upon. One may be certain to expect twenty different answers.

The remainder of expenditure may be taken under one heading, that of general and law charges. These also include compensation, parliamentary expenses, rates, taxes, and health and unemployment insurance, which altogether only amount to 7 per cent. of total traffic receipts. Adding these various percentages up it will be found that they amount to 85 per cent. It will be agreed that these miscellaneous charges are for all practical purposes fixed. In 1914 this figure amounted to about 65 per cent. During Government operation the figure rose to over 100 per cent., there being an actual deficit on operation, primarily owing to the fact that fares and rates had not been raised in proportion to the rise in the cost of materials and wage rates. Quite recently this figure for the Etat Railway of France stood at 114 per cent. The operating ratio is an important index to a railway's operating efficiency, although it has little bearing

on the power to earn dividends, for although the operating ratio is low and hence favourable, the volume of traffic may be so small as to prevent the accumulation of sufficient revenue to cover more than the interest on fixed charges. Hence with an over-capitalized line even an operating ratio as low as 60 per cent. may not necessarily bring in a dividend.

The remaining 15 per cent. is known as net income. The first deduction from this is interest on loans, debentures and bonds, whose owners are the creditors of the Company, rent charges, tithes, and way leaves. These account, on our British railways, for about 7 per cent. out of the 15 per cent. which represents net income. The remaining 8 per cent. of traffic receipts is available for dividend and interest on the money subscribed by the stockholders. First comes the Guaranteed Stock, with about a 4 per cent. return, a fixed percentage ; secondly come the Preference Stocks with about the same return, also a fixed percentage. Thirdly, in the case of two railways there is the Preferred Ordinary Stock with 5 per cent., and lastly the Deferred Ordinary Stock, which can only be paid if the preferred holder has received his 5 per cent.

Dividing up revenue into the days of the year it will be seen from Table VII that it took the following number of days to earn sufficient revenue to pay for the varying items of expenditure in a recent year on one British railway.

TABLE VII

	Per cent.	
Renewal of Track	12	44 days
Renewal of Rolling Stock	16	58 ,,
Locomotive Running Expenses	21	77 ,,
Traffic Expenses	29	105 ,,
General Charges (Compensation, etc.)	7	26 ,,
Taxes, Rates, etc.	8	20 ,,
Interest on Stocks and Shares	7	26 ,,
	100	365 days

As a comparison, on the American railways, out of the gross revenue of an entire year, it took the receipts of :—

151 days for wages.
24 days for locomotive fuel.
69 days for materials and supplies.
24 days for all other operating expenses.
22 days for taxes.
40 days for interest and rents (fixed charges).
23 days for dividends.

These figures are based on the 1926 figures for Class 1 American Railroads and are applied to the 366 days of 1928; present indications are that 1927 figures will not alter this distribution by more than a few days.

This leaves only thirteen days for improvements out of earnings—or to make up losses of former years—or to help create reserves against bad years in the future.

There are three main sources from which railway financial and statistical information can be derived so far as the railways of this country are concerned: the Companies' Annual Reports; the Monthly Statistics published by the Ministry of Transport; and the Yearly Returns in which the information is largely a summary of the Companies' annual reports, added to which is a very valuable résumé of the situation. A Railway Company's Annual Report is submitted by the Directors to the shareholders at the Annual General Meeting of Proprietors which takes place usually towards the end of February. It takes the form outlined for such reports by the Railway Companies' (Accounts and Returns) Act of 1911. For some time prior to this date the companies had been required to prepare half-yearly accounts, but it was recognized that the extra expense of their preparation was not balanced by any added advantages. The growth of regulation gradually improved the scope and manner in which the railways presented an account of their financial transactions and the number of passengers and amount of freight they carried. An earlier chapter on regulation will have shown the general trend; it suffices to say here that the 1911 Act was the culmination of a long series of Acts dealing with the financial and traffic statistics of the railway companies.

Since 1911 two important Acts have affected this

question: namely, the Ministry of Transport Act, 1919, which amongst other things made compulsory the use of the ton-mile and passenger-mile; and the Railways Act of 1921, which gave the Minister of Transport further powers relative to the collection of statistical data; nevertheless, it remains true as a generalization that the present Annual Report is in the same form as that laid down by the Accounts and Returns Act of 1911.

The Annual Report must be outlined very briefly; after giving a list of directors, there follows the Directors' Report for the past calendar year ended December 31st. There is little need for comment on these; the directors retire in rotation and usually offer themselves for re-election by the shareholders. If a vacancy occurs by death, the directors nominate a successor who is almost invariably accepted by the shareholders. Voting is carried out according to the number of shares held, and proxy voting is permitted if a shareholder is unable to attend. Unlike the position in America, in this country the shareholders elect their own auditor, thus they have a check on the Report made by the directors. Additionally, of course, the Ministry of Transport carefully scrutinizes the Companies' Accounts. The safeguard in the United States is the Interstate Commerce Commission Auditor, to whom a report has to be sent of every item of capital expended above a comparatively small amount. This is to ensure that revenue is not expended upon new capital works and thereby the receipts camouflaged and rates kept at too high a level. The American Clayton Act of 1914 regulates the dealings of the railways with contractors.[1]

The British Annual Report is divided into two portions —the financial accounts and the statistical returns.

[1] According to Section 10 of this Act, "No common carrier can have any dealings in securities or supplies, or make any construction contracts, to an amount exceeding $50,000 in one year with a concern in which a director, president, manager, purchasing agent of the carrier is directly interested unless submitted to competitive bidding. Penalty: (1) Fine of $75,000 (maximum) on railway plus (2) fine of $5,000 (minimum) or jail sentence on railway official.

Account No. 1*a* in the financial accounts shows the Nominal Capital Authorized and Created by the Company. The first thing of note about this table is that the capital actually created is very much smaller than that authorized to be raised, the heading "Capital Authorized" giving the amount of stock authorized in the respective Acts. "Capital Created" represents that portion of the authorized capital which the directors decide to create and the last column is, of course, the balance.

The proportion between shares and stock and loans and debentures of all capital created is not very different in most cases from the proportion of 66 to 34 per cent. This is a very important point as it affects the credit of the Company; 40 to 60 per cent. is a very safe proportion between them. Debentures and loans on some of the American lines run to 55 per cent. of the total issued capital and, therefore, it will be seen that there is relatively little security in such cases for the debenture or bondholder,[1] as he is called in America. The following figures show the net capitalization of the American steam railways in 1925:—

Capital Stock.	Funded Debt.	Total Capital.
$6,885,437,186	$11,305,076,143	$18,190,513,329

It is patent that the ownership value, namely the assets held by the shareholder, should be greater than the amount the debenture holder has a claim upon. One may ask why the tendency should be for the percentage of debentures to total capital to grow. Owing to their superior safety the interest on debentures required to induce the loan of capital is less, hence the railway does not have to pay such a high price, that is, interest on the money raised in this way.

Account No. 1*b* refers to Capital Raised jointly and is not of great importance. Account No. 1*c* relates to the Capital of Lines Owned jointly, as, for instance, the Midland and Great Northern Joint Railway, which,

[1] American railroad finance is much more complicated, due to the existence of mortgage bonds with very complex arrangements regarding security.

as a result of grouping, is now London, Midland and Scottish, and London and North Eastern joint property.

Account No. 2 shows the Share Capital and Stock actually Issued as compared to that nominally created; the difference gives the amount of nominal additions. "Capital Created" appears in Account No. 2, in which also will be found the Amount Issued, giving the amount which appears in the Receipts side of Account No. 4. This figure, with the amount shown in Account No. 4 as Balance of Premiums and Discounts, represents the actual cash received. A third column represents additions which have been made in excess of the amount issued, in order, generally speaking, to make stock more marketable. Many of the ordinary stocks of the pre-amalgamated Companies were divided into Preferred Ordinary Stock, carrying a prior claim on the dividend, and Deferred Ordinary, which obtained what was left. A fourth column in Account No. 2, entitled Nominal Additions or Deductions on Amalgamations, had to be inserted to provide for the alterations consequent on amalgamation. It is important to note that the last two columns in Account No. 2, entitled Amount on which Dividend is Payable and Amount Unissued, agree with the first column, as, of course, authority must be obtained for nominal additions, but cash is only received in respect of the amount issued plus or minus premiums or discounts. Nominal capital involves capital indebtedness without an equivalent cash receipt, and consequently the amount on which dividend is payable becomes greater than the amount of cash received, but not greater than the amount created.

The tendency has been and will be to reduce the various stocks into fewer classes. The only advantage of subdivision is that it enables each investor to choose the stock most suited to his desire for security, long-term investment, or speculation. The main advantage of consolidating these stocks is that it gives each a better market, that is, makes them more marketable, and, hence, the buyer and seller benefit by a truer and steadier price.

Account No. 3, Capital Raised by Loans and Debentures, gives the amount of money borrowed at different set rates of interest. Rates may vary from 3¼ to 7 per cent., but the latter is very high for British railways. The shorter the period the more one has to pay in interest as a general rule. As soon as a loan carrying a high rate of interest falls due for repayment it will tend to be replaced by a loan borrowed at a lower rate, if the general level of interest rates is falling. The next part of the table shows the Debenture Stock particulars, and the redeemable Debenture Stocks.

Account No. 4, Receipts and Expenditure on Capital Account, which divides the total amount expended as capital on the railway, steamers, docks, and hotels, totals in all more than the capital actually issued and subscribed for in the form of debentures and stocks and shares.

Account No. 5, Details of Capital Expenditure, is worthy of close study, as it gives a bird's-eye view of the progress being made over all parts of a railway system. Usually in recent years this has consisted mainly of widenings and reconstruction rather than new construction work. The conversion of refuge sidings into loops, or the lengthening of either of these, is likely to incur much capital expenditure in the near future. With more powerful engines and high labour costs, it is becoming more and more essential to raise the revenue load per freight train higher than 140 tons. It is interesting to observe that this revenue load has been increased from 500 to 700 tons in fifteen years in the United States. Admittedly conditions are very different here, but some improvements should be possible ; however, this problem will be discussed at length in a later chapter. Under the head of Rolling Stock considerable sums have recently been spent on steam heating apparatus for carriages and on engines. The main effect made by such a table is the fact that there are so many demands for new capital expenditure, from small 10 horse-power plants to electrification of all lines 40 miles from London.

Account No. 6 shows the Estimate of further Expendi-

ture on Capital Account, and in recent years of bad trade has been a source of depression, for many urgently needed programmes have had to be shelved until better times. Thus from this table one can compare work in progress with that in abeyance. Railway Companies are constantly being urged to undertake large schemes of betterment in times of depression to relieve unemployment, with special reference to those schemes which will have, of necessity, to be undertaken during the coming years. Such a policy is the subject of much division of opinion amongst economists and raises the whole question of whether unproductive work such as road construction should be financed to relieve unemployment. One rather inclines to the view that it is not economic to proceed with such works in times of depression, for with low credit due to reduced traffic, the cost of raising new capital must be high. A vicious circle appears to exist here, as it does in the case of higher prices, higher cost of living, higher wages and still higher prices. In this case we have an example of a railway requiring improvements, yet lack of traffic prevents it from giving orders to improve the volume of production; though often, without the completion of these betterments, the railway cannot lower its cost of production and consequently reduce its rates.

It is possible that the French system of local loans repayable by surtaxes on the traffic benefiting from the improvements may prove the best solution to this position of deadlock. In short, capital expenditure can only be paid for out of revenue or from newly raised capital. Of the former in recent years there has been no surplus, and the latter could only have been raised at so high a price as to make the policy unacceptable, not only to the railways, but in reality to the users of the railways, who, in the end, out of passenger fares and freight rates, would have had to pay the interest.

It must not be thought that no capital expenditure has been undertaken since the amalgamation; large rolling stock programmes, the electrification of the Southern Railway's suburban lines, the building of new

cross-Channel steamers, the rebuilding of freight stations, are conspicuous examples. It is not always realized that over £30,000,000 of additional capital has been raised by the British railways as a whole between the end of 1922 and the end of 1926, in spite of the depressed condition of trade. In his annual speech in 1927, as Chairman of the L.M.S.R., Sir Guy Granet called attention to the fact that this railway alone had expended £21,500,000 on new rolling stock and plant for its manufacture in the four years 1923–1926 inclusive.

Account No. 7 shows the Capital Powers and other Assets available to meet further expenditure; it must be studied in connection with the previous Account and with Account No. 4, and does not warrant further mention, whilst Account No. 8 gives the Revenue Receipts and Expenditure of the whole undertaking and demonstrates at a glance the position with regard to the ancillary services, such as Docks, in addition to giving the interest derived from holdings in other Companies.

Account No. 9, the Proposed Appropriation of Net Income, is one which naturally engrosses the close attention of the shareholders, but its interest is not great to the student of railway economics, nor is Account No. 9*a*, a Statement of Interim Dividends paid.

Account No. 10, Receipts and Expenditure in respect of Railway Working, is, on the other hand, probably the table of greatest interest in any railway report. On the expenditure side it shows the division into the costs of maintaining and renewing way and works, and rolling stock, as well as locomotive running and traffic expenses. The expenditure side is completed with the fixed and overhead charges, such as rates, taxes and law charges, in addition to compensation, and so forth. The proportions of these have been dealt with earlier in this chapter, as well as the varying divisions of the receipts side of the table, such as passenger train traffic, including season tickets; mails and parcels; and freight train traffic, including live stock and demurrage; thus further explanation need not be made here.

Account No. 10 is followed by a series of Abstracts,

A to J, which show in detail the expenses entailed under locomotive running and maintenance and renewal of rolling stock, and other expense headings. The main interest in these Abstracts lies in the general trend which they demonstrate from year to year, but the life of the present Companies has been so short in their grouped form and the last four years so abnormal, that even the trend itself is of little value upon which to base very definite economic judgments.

Accounts No. 11 to 17 show the detailed Receipts and Expenditure of the various ancillary services, which have already been discussed from the point of view of the railways as a whole. Account No. 18 concludes the Financial Accounts half of the Annual Report by the General Balance Sheet. Part II of the Annual Report consists of the Statistical Returns and is discussed in the later chapter entitled Railway Statistics.

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CHAPTER IV

THE RAILWAYS AND THE TRADER

It is hard to over-emphasize the necessity which exists for a very close type of co-operation between any organization which has a product for sale and the intending purchaser of that product. Without co-operation there is a tendency for one side or the other to obtain an unfair advantage either from increased information as to the value of the product or from unfair bargaining power, which latter is the root objection, economically, to the monopoly or combine. It should be remembered that every sale of an article increases the mutual satisfaction of both sides, since to the seller the article has not cost what he is able to sell it for, whilst presumably the buyer will not have given the price he has unless he considers it worth, to him, more than that price. There are two exceptions—the case where ingenious advertising persuades some one to buy something they do not want, either a packet of cigarettes, a new type of hat, or a day at the seaside on golden sands which fail to materialize; and the case where the seller through changing price levels, or bad calculation, sells his goods at a loss. Generally speaking, however, it is true that any selling transaction does constitute an increase of mutual satisfaction. The fairer the price the greater will be the sum of satisfactions.

Now a railway does not manufacture a product, but it does offer for sale a service, namely that of transport of commodities and passengers. Thus, it is essential for it to be in close touch with the buyers of this service—the travelling public and the traders—if both sides are to obtain the maximum advantage. This in its turn will benefit the nation and society as a whole.

The importance of co-operation between the traders and the Railway Companies has never been more necessary in the whole history of British railways than it is to-day, since British railways can no longer be regarded as monopolies, owing to the rise of road motor competition. The necessity of spreading overhead or fixed costs over as large a volume of traffic as possible is the cardinal rule of railway operation and railway economics, and it is only by this method that the level of rates can be reduced and passenger fares lowered.

Many obvious advantages accrue from harmonious feeling between the traders and the Railway Company. The possibilities of an organization by which mutual discussion can take place, which would aim at the adaptation of railway service as nearly as possible to the needs of the trader, and the adaptation of the traders' organization to the efficiency of railway working, for example, by use of larger wagons to reduce the costs of operation, are immeasurable. A train of sixty 10-ton wagons has a gross weight of about 975 tons when carrying 600 tons of coal, with a length of 1,170 feet; but if thirty wagons of 20 tons capacity were used to carry the 600 tons of coal, the gross weight would be 907 tons, with a length of 690 feet. If 40-ton wagons were used only fifteen would be required, and the gross weight to be moved would be the same, but the length would be reduced to 591 feet. Even if no reduction could be made in charges increased facilities could be given for the same price.

British railways, and British traders too, appear to have been rather backward in agreeing upon any basis of organization which would be suited to dealing with this problem of the mutual elimination of difficulties arising from service offered. In India, on the recommendation of the Report of the Acworth Commission on Indian Railways, Local Advisory Committees, and a Central Advisory Committee have recently been introduced. Time has, as yet, been too short to judge of their success, but the Committees appear to be serving a useful purpose. With millions of wholly illiterate people the question is

an entirely different one from that in Europe or North America, and is peculiarly difficult. There is a tendency to treat the Advisory Committees purely as complaint bureaus, which naturally is not their true function. It is interesting to observe that, in contrast to the secret policy which has always characterized meetings of this nature in this country, the principal newspapers in India publish a summary of the proceedings of each meeting.

In France, the Superior Railway Council acts as a medium between the railway officers and the trading community, and is used to discuss problems of co-ordination affecting both. In this country until recently there has been no really clear channel through which complaints might reach the railways. The press is a somewhat too vehement medium which often does not conduce to good feeling between the two sides. The Mining Association, the Iron and Steel Trades Federation, and other similar groups, are all too much one-sided in their requests, and, quite naturally, put forward only the views of their own particular trades, regardless of the damage which such requests may do to other trades. The Railway and Canal Commission was, and is, primarily a judicial body, before which it is expensive to bring cases, and it is possible that many cases actually brought before it could have been avoided if some alternative channel leading to mutual discussion had been employed.

Since the war, however, there have been considerable improvements, even if they have not yet developed to the extent for which many of us still hope. The Federation of British Industries has grown up, which is not a local body or representing any one trade, and is largely qualified to speak and to get into touch with railways on behalf of many trades in this country. The Rates Advisory Committee, too, was set up in 1919, and commenced work in 1920, inquiring into the need for an increase in the level of rates. It consisted of representatives of trade and commerce, labour and agriculture, with a distinguished lawyer as chairman, and inquired into the existing position, and, as a result of its recommendations, certain increased rates were put into effect.

The Railways Act of 1921, however, altered the position again, and started a new era for the railways of this country. Under Clause 20 of that Act a Railway Rates Tribunal was set up, which was to take the railway rates work out of the hands of the Railway and Canal Commission. As a result of the rate-fixing work, in connection with standard revenue, to be done by the Railway Rates Tribunal, a special Railway Committee was formed, whose duty it is to discuss with the Traders' Co-ordinating Committee the problems that are due for a hearing before the tribunal. This method of bargaining has been remarkably successful, and has resulted in far less argument before the Railway Rates Tribunal itself.

In addition the Railways Act of 1921 (in Clause 28) suggested that Local Joint Committees be formed at which local problems of service and complaints might be discussed. There has been extraordinary delay in the setting up of these Committees, partly due, perhaps, to the state of flux which is found to exist until the rates which came into force on the "Appointed Day" have been longer in use. Bradford started a local committee and submitted its composition, as the law suggested, to the Railway Rates Tribunal; there was recently a committee functioning successfully at Newcastle, but on the whole the position is disappointing. It may be that the Joint Committees are too local in their nature, that is to say, the Midlands would be a better area to cover than the Birmingham or Rugby district. If one debars from discussion the question of rates and fares, which are, in any case, not suitable for local argument and can only be altered by the Railway Rates Tribunal, the whole conference is likely to have more success and to result in better work. The improvement of service is just as important to the average trader as a small rise or fall in rate levels, and the problem arises in acute form in England to-day. Mutual explanation between the trader and the railway is highly desirable and a better understanding of the other's difficulties is an achievement to be aimed at. When a railway can, it should improve its

speed of transport; in fact, it must do so if it is to compete successfully with the road services.

In Germany there existed for many years a system of District Councils, with a railway official as secretary, the chairman being the president of one of the State railway "direktions" or divisions. In practice the agenda for each meeting was arranged by the railway, and sub-committees were appointed to deal with the various problems under discussion. These German councils were noteworthy in that they included within their scope the discussion of rates, and when an increase in any rate was announced six weeks' full notice had to be given, but there was no appeal against such increases. In Prussia a large part of their work consisted in discussing the problem of "ausnahme" tariffs or exceptional rates, in addition to questions arising out of the alterations in time-tables and passenger train accommodation.

The power of the district councils varied considerably in the different German States, and apparently they were not regarded as so important in Bavaria and Saxony, where they dealt mainly with passenger train and traffic problems. In no case did they exercise any authority whatever over the railway administrations, though they undoubtedly exercised a sort of moral pressure on the railway, since their deliberations were published and any recommendations of the standing tariff commission were submitted for discussion at the meetings. A most interesting account of the organization of these councils may be found in the Accounts and Papers for the 1909 Session of Parliament, in which is included a "Report on the Railways in Germany" by C. H. Pearson and N. S. Reyntiens in the Report of the Board of Trade Railway Conferences. It is doubtful if such a system would be applicable in Great Britain with our privately owned railways, and it could hardly be expected that the traders' organizations would look with favour upon a system which so obviously places the balance of advantage with the railway administrations. The fact that railway systems, at any rate in Great Britain, are no longer able to regard their services as non-competitive with other

means of transport completely changes the whole aspect of this vital problem of co-operation between the buyer and seller of transport facilities.

Of far greater import to the British railways and to the traders of this country is the growth of the Shippers' Advisory Boards Scheme in the United States. Springing from the fertile brain of Mr. Donald Conn, at that time Assistant Manager of the Car Service Division of the American Railway Association at Washington, the first Regional Shippers' Advisory Board was organized in the North-western States on January 16th, 1923, and has been followed by thirteen additional Boards which cover virtually all the great territory of the continental United States. Thus the trader, or shipper, as he is called in America, by means of these Boards has access to the railways through an official organization which will look into his criticism or complaints, turn them down if they are irrelevant or take the matter up through the Railroad Contact Committee if there are constructive ideas behind them.

The American railways emerged from Federal control in 1920, and at that time were in a condition which could only be described as appalling. The rolling stock was out of repair, the staff in many cases were dissatisfied, the permanent way had large arrears of maintenance, whilst many lines found that only 20 per cent. of their freight cars were on their own tracks, and it took nine months to obtain their final return. There resulted a slow service of poor quality, and although there was comparatively little talk of nationalization there was continual ferment at Washington on the whole railway problem, which was primarily caused by dissatisfaction amongst the agricultural community, mainly situated in the Middle West and North West. The price of farm products had slumped while farm costs kept high, and moreover freight-car shortages in the autumn months created much ill feeling against the railways. The latter, realizing that some courageous policy must be adopted, backed up worthily the programme put forward by Mr. Conn; and in the words of one who has been most closely connected with

the progress of the scheme, "it is now conceded that a great national service was rendered by Mr. Conn." By 1923 the American railways had definitely overcome their most critical period, in spite of the set-back caused by the shopmen's strike of 1922, but their progress during the last four years has been in large part due to the formation of these Boards, without which the co-operation of the trader could not have been obtained, and without that co-operation maximum efficiency could not have resulted.

Probably closest to British conditions are those appertaining to the territory covered by the Atlantic States Regional Shippers' Advisory Board, since nearly every form of industry exists, and every type of rail transport service is demanded, in this area. What is true of this Board is also true as a general proposition of all the others, although this one is fortunate in having as its Chairman Mr. J. L. Banham, Traffic Manager of the Otis Elevator Company, who has put heart and soul into the scheme and who is, in no small part, responsible for its success.

Looking into the organization of this Board, one learns that its management is in the hands of an executive committee. This executive committee receives the reports of the Railroad Contact Committee, consisting of representatives of the fourteen big railways serving this territory, with J. W. Roberts, the General Superintendent of Transportation, Eastern Region, Pennsylvania Railroad system, as its Chairman, and the Transportation Assistant to the President, New York Central Lines, and the District Manager, American Railway Association, as vice-chairmen. This latter committee also furnishes reports to the Executive Committee, while at each meeting, of which there are three or four a year, according to the locality of the Board, reports are received from the various Commodity Committees. In these reports criticism of railway service is both requested and desired. Typical examples of the Commodity Committees in this territory are as follows :—

Automobile Committee.

Automobile Parts and Accessories Committee.

Brick Committee.
Canned Goods and Preserves Committee.
Cement Committee.
Chemicals Committee.
Clay and Clay Products Committee.
Coal, Coke, and Ore Committee, etc.

It will be seen that the interests of each productive industry are well looked after, and the help these committees have given the railroads has been most important, both in obtaining quicker release of freight cars, better cleaning of the cars, better loading of the cars, and also forecasts as to the traffic which is likely to be handled during the coming ten or twelve weeks. During 1927 for the first time the forecasts of these committees of all Boards have been combined to give a national trade forecast. A similar forecast in Great Britain would be of immense advantage to our own railways. On the shippers' side better service has resulted as well as all the improvements consequent upon a regular line of communication by which criticism and complaints of railway service can be aired and efforts made for betterment.

Friction usually results from lack of contact, and in this way the Shippers' Boards have eliminated many difficulties and engendered an atmosphere of trust and confidence which goes far to explain the progress made by the American railways and other industries during the last four years. Elisha Lee, Vice-President in Charge of Operation, Pennsylvania System, before this Board in 1925 is quoted as saying :—

" In bringing about this era of better feeling and finer results, no agencies have been more powerful and effective than the Regional Advisory Boards, of which this is the largest and most important with respect to the amount and value of traffic involved.

" Let me summarize briefly the principal things that have been achieved in this country since our era of good feeling in the transportation field became a reality—that is, within the last five years.

" In the first place, our railroads are rendering a

quality of service which in dependability, reliability, satisfactory rate of movement and safety is the best in their history.

"Second, they have handled the largest volume of traffic ever moved by the transportation systems of this or any other country, largely exceeding even the peak movements of the wartime period.

"Third, they have successfully met record-breaking demands for service with no general, and very few local, car shortages—a thing no one would have believed possible ten or a dozen years ago.

"In the fourth place, the country as a whole has enjoyed the greatest prosperity it has ever experienced, while the living standards of our individual citizens have been raised to levels the highest on record for Americans, which means far above anything ever attained by the people of any other land."

Secretary Hoover in his annual report of the Department of Commerce for 1926, referred to the Boards in the following way :—

"Probably the most outstanding single industrial accomplishment since the war has been the re-organization of our American railways. Our transportation was not only demoralized by government operation during the war but had suffered from chronic car shortages and insufficient service, not only after the war but for many years before. The annual loss from this periodic strangulation in transportation was estimated in the department's annual report of 1925 to amount to hundreds of millions a year. The insufficiency of transportation interfered with steady industrial operations, created intermittent employment, increased the costs of production and, through periodic strangulation, caused high prices to the consumer. Manufacturers and distributors were compelled to carry excessive inventories as a protective measure, thus not only increasing the amount of capital required in the business, but multiplying the danger of loss by price fluctuation."

The following shows the objects which the Boards set out to attain and have attained with remarkable success,

and is extracted from a Publicity Bulletin of the Kansas City Southern Railway; but identical words have appeared in many of the Boards' Reports and upon leaflets distributed by the railroads :—

"The activities of these regional advisory boards might be summarized as follows :—

"1. To form a common meeting ground between shippers, local railroads, and the carriers as a whole; to analyse transportation needs in each territory, and to assist in anticipating car requirements.

"2. To study production, markets, distribution and trade channels of the commodities local to each district with a view of effecting improvements in trade practices when related to transportation, and promoting a more even distribution of commodities where practicable.

"3. To promote car and operating efficiency in connection with maximum loading and in the proper handling of cars by shippers and railroads.

"4. To secure proper understanding between railroads of the transportation needs of shippers, that their regulations may fit shippers' requirements, and to secure understanding between shippers and their co-operation in carrying out necessary rules governing car handling and car distribution.

"5. To acquaint shippers and railroads in each section of the country of the seasonal requirements in their section, in order to promote intelligent co-operation in the handling of equipment between the different districts of the country.

"6. To adjust informally car difficulties which may arise in each local territory between the carrier and shipper.

"7. To give the shipping public a direct voice in the activities of the Car Service Division on all matters of mutual concern.

"Much good has been accomplished and better transportation service secured through these co-operative results.

"These Regional Boards have the hearty commendation of the Interstate Commerce Commission; of the

Honourable Herbert Hoover, Secretary of Commerce, and of shippers and railroads generally."

Expressed shortly, the purposes and objectives were for the Boards to form a link between the shipping public and the railroads as a whole; as that they work in the closest harmony on common problems of mutual concern. To one who first called attention, in 1924, in Great Britain, to the success of this scheme, the argument has always been used that legislation has provided for the setting up of similar bodies in this country as local joint committees under the Railways Act of 1921. Legislation does exist, it is true, and several committees have been set up, yet no one can claim that their successes have attracted the attention of the nation. It is in a way a mockery that legislation should be required to permit two people to talk over a common problem; the whole point of the American system has been missed, and deliberately missed, for its success is mainly due to three things: Firstly, the whole-hearted co-operation of both sides, the railways and the traders, both of whom welcome criticism if it be constructive and tends to assist the common weal. Secondly, the areas covered by a Board are wide, and to obtain similar conditions three Boards at most would cover Great Britain. Thirdly, the controversial element of rates is absent. Small local joint committees as visualized in our Act can never be great successes because interests are too local; the main business will hinge always upon petty complaints, mainly with regard to rates and charges, and the chief executive officers on the railways will never have time to attend them.

To compare the Traders' Co-ordinating Committee in this country, which has effected such excellent work before the Railway Rates Tribunal, with the American Regional Board System is to ignore the difference that the latter does not touch rates questions. The Traders Co-ordinating Committee definitely studies rates questions and fights for the lowest rate scale possible. It is too often forgotten that traders often pay as much attention to questions of service as to that of rates. The saying is common in America and is not uncommon here that a

large trader suffers more through bad service than through a slightly higher level of rates. Given the choice he will prefer the latter. The necessity of holding a larger stock of raw materials and spare parts will create interest, insurance, and accommodation charges, which will easily offset the lower rate structure. Good feeling and co-operation between buyer and seller are essential in every industry, but in none are they more important to the social well-being than between the railways and their users.

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CHAPTER V

THE RAILWAY CLEARING HOUSE

Soon after the railway era commenced it became evident that some sort of clearing system would have to be devised to facilitate the transfer of passengers and freight from one railway to another. The delay, inconvenience, and expense which arose from the necessity of transhipping goods and re-booking passengers at junctions where two lines exchanged traffic very early became intolerable. Even in the old coaching days some kind of reciprocal clearing system appears to have been in use, but it only applied to through bookings. In the early railway era through tickets were issued by way of Selby, which involved a road, rail and water journey for a short period ; but such arrangements were extremely rare until after the Railway Clearing House came into being on January 2nd, 1842.

It is uncertain whether the idea originated with Mr. George Carr Glyn (afterwards first Lord Wolverton), Chairman ; Mr. Robert Stephenson (son of George Stephenson), Engineer ; or Mr. Kenneth Morison, Chief of Audit Department, all of the London and Birmingham Railway, or with Mr. (afterwards Sir) James Allport, who became a director of the Midland Railway. Mr. Glyn undoubtedly threw the whole weight of his influence into supporting the idea, and entrusted the working out of the details of the scheme to Mr. Kenneth Morison. After much opposition the Railway Clearing House was established with a staff of four clerks in an office adjoining Euston Station, and became an essential part of the railway machine. Mr. Morison was first part-time Manager, but later became its first Secretary. Nine Railway Companies appear to have composed the original

membership—the London and Birmingham, the North Midland, the York and North Midland, the Midland Counties, the Manchester and Leeds, the Hull and Selby, the Birmingham and Derby Junction, the Leeds and Selby, and the Great North of England. To any student of railway history of those times it will not be surprising that Brunel's broad-gauge Great Western Railway was not an original member.

The growth of the Railway Clearing House was sure but slow ; by 1845 a further seven Companies had joined, and the mileage of these sixteen lines amounted to over 600 ; by 1920 the mileage coming under the Clearing House regulation amounted to approximately 23,000, belonging to fifty-eight different Companies. As a result of the Railways Act in 1921, and the Irish Railways Act of 1924, the present membership of the Railway Clearing House is seventeen, though the mileage remains practically the same. The highest number of persons ever employed by the Railway Clearing House has been 3,400 (including number-takers), but gradual reductions have been made as a result of the grouping, though the present staff at Seymour Street, near Euston, is just under 2,000, whilst there are about 600 Railway Clearing House number-takers employed at transfer stations between the groups all over the country. In 1842 the Clearing House dealt with receipts totalling £193,000 ; in 1924 receipts dealt with totalled £52,363,474. The number of entries recorded at junctions, of stock exchanged, has risen from 8,526,249 in 1865 to 13,501,654 in 1927.

Prior to 1850 the Railway Clearing House was unable to enforce payments due by one Company to another, since it possessed no legal status, but in that year the Railway Clearing Act was passed which gave the Clearing House authority to sue, in its own name, the debtor Company. Since 1897 it has possessed the privilege of a corporate body and possesses a seal of incorporation. In 1922 the Railways Amalgamation Tribunal approved the Railway Clearing House Amalgamation Scheme, which placed the control of the Corporation in the hands of four delegates from each amalgamated Company, and

one delegate from each Company other than an amalgamated Company. The present Chairman, Sir Edmund R. Turton, Bart., M.P., is a late director of the North Eastern Railway. An executive committee of nine members, known as the "Superintending Committee," is elected from the delegates, and consists of two delegates each from the four groups in addition to the Chairman. The Executive Officer of the Railway Clearing House is the Secretary; Mr. P. H. Price, the present Secretary, being the sixth holder of that position.

The main object of the Clearing House organization was the obtaining of through booking for passengers and freight between all the Companies, while it is the duty of this neutral organization to divide up and account the proceeds of revenue derived from through tickets and through freight charges. In the majority of cases passengers have to change carriages when transferring from one line to another, although possessing through tickets, since the amount of through traffic will not warrant through trains. With freight, however, the problem is entirely different; through wagons are the general rule, and thus transhipment, with all the expense and delay it entails, is avoided. At transfer junctions where carriages, wagons, and sheets pass from one Company to another, their numbers are recorded by the Railway Clearing House number-takers.

The work of the Railway Clearing House is divided into three departments, viz.: (1) Secretarial Department, which is sub-divided into two sections—"General" and "Mileage," (2) the Merchandise Department, and (3) the Coaching Department.

Secretarial Department

The General Section of the Secretarial Department deals with the administration of the establishment, staff matters, etc., and the maintenance of the extensive premises. It is responsible for the general organization of the multitudinous meetings of general managers and departmental officers and their representatives held at the Railway Clearing House, and occasional meetings

with representatives of various trade organizations; being neutral ground, it is favoured by the Companies for this purpose. The vast amount of the work associated with the determination of the Companies' rates, fares and charges as from the "Appointed Day" (January 1st, 1928) is dealt with by this section. It is also responsible for the work connected with the compilation and issue of various publications used by the Railway Companies and the public, as, for example, the General Railway Classification of Goods, Coaching Arrangements Book, Scales of Rates and Charges, Specifications and Drawings for Private Owners' Wagons. The Distances Sub-Section compile the mileages which form the bases for the division of through rates, and also prepare and issue numerous official Railway Maps and Junction Diagrams, as well as the Handbook of Stations, Sidings, etc., in the United Kingdom.

The Expenditure Sub-Section sets out the results of the division of Rates and Fares, and balances the credits against the debits for each Company, in the same way that the Banks effect the cheque clearances and accounts between one another.

Returns of the records taken by the Clearing House Number-taking Staff at the various junctions throughout the country of the wagons, sheets and coaching stock which pass from one Company to another are dealt with by the Mileage Section of the Secretarial Department.

To compensate the Forwarding Company for the loan of its coaching stock to the Receiving Company a charge known as "mileage" is made. The mileage charge is fixed by a tariff and includes an obligation on the Receiving Company to return the stock within certain periods and in certain directions according to circumstances. If the stock be not returned within the stipulated period or by the appropriate route, the Receiving Company is subject to a penalty, which is known as a "Demurrage" charge. The charges for and against each Company are balanced and the net amount credited or debited periodically.

Goods stock is now looked upon as common property

and is subject to what is known as the "Common User" arrangement, with the exception of certain special categories which are traced and dealt with in the same manner as Coaching Stock. Under this arrangement a Company is considered as entitled to have on its line at a particular date a certain number of wagons calculated on the following principle. A Company which forwards more traffic than it receives (for this purpose called a "Forwarding" Company) always has a number of its wagons on the lines of the Companies to whom it forwards the traffic. At any given time, therefore, a "Forwarding" Company should have on its own line a number of wagons equal to its own stock less the number on the lines of "Receiving" Companies, while conversely a "Receiving" Company (that is a Company receiving more traffic than it forwards) should have a number equal to its own stock plus the number received from "Forwarding" Companies.

A census of the wagons on each Company's line is taken periodically and Companies shown as holding more than their share of wagons hand the surplus to those Companies which are shown as holding less than the number they are entitled to. Thereafter, daily records are taken at all junctions of wagons, both loaded and empty, exchanged between Companies and these records are sent to this Department twice weekly. The numbers are then balanced, and if a Company during the period has received more wagons than it has forwarded, it is advised by the Clearing House of the number due to be returned together with the name of the Company or Companies to whom the vehicles are to be sent and the junctions through which they should pass. The settlement is made by the Clearing House three days after the expiration of the three-day period to which the records refer and the wagons have to be returned in equal daily proportions each three days thereafter. Thus, six days after a wagon has been received by a Company, a wagon in payment must be returned to the forwarding Company, otherwise a charge per day is levied as a penalty until the debt is cleared. A similar arrangement operates as regards wagon sheets.

The adoption of "Common User" has considerably curtailed the work and has also resulted in economy of "empty" haulage. Under the mileage regulations formerly in operation wagons as a general principle had to be returned to the owning Company and this caused unnecessary empty haulage, as frequently at a junction a Company would return empty wagons to another Company and at the same time receive from that Company its own empty wagons.

It is not possible within the compass of this chapter to detail the working arrangements by which the three days' balance is made, but it may be of interest to state that exchanges of stock, most of them subject to the "Common User" arrangement, are recorded at nearly 800 points, that over a million of exchanges of goods traffic vehicles are made monthly, and that returns giving the numbers of such exchanges are received by the Clearing House, so that every Tuesday and Friday morning each Company concerned is advised of the numbers and places of exchange of wagons due to other Companies, such exchanges commencing at 4.0 p.m. on the day of advice.

The majority of the Railway Companies' goods stock is subject to the "Common User" arrangement, but the Companies are entitled to payment for the use of vehicles passing on to another Company's line. As the "Common User" wagons are not traced individually to their respective destinations, mileage charges are not based, as was formerly the case, on the distance travelled on the non-owning Company's line, but are levied by means of a charge per wagon journey, which is known as "Journey Payment." This charge varies as between particular pairs of Companies, the rates at present in force being based on an agreed mileage scale.

As regards railway-owned wagons containing coal and other mineral class traffic the charge for the use of the stock is met by a "Wagon Hire" payment.

In the United States, the Car Service Division of the American Railway Association superintends this work, the standard charge for which is one dollar, or four

shillings and twopence per day; but it is not sufficient to prevent the small line keeping the best water-tight grain cars on its own line during times when trade is good, and there tends to be a shortage of freight cars, to the great disadvantage of the owning line, which may want every water-tight car it can have to move the grain from the prairie States. In France, practically all wagons are common users and the balance of traffic is arranged by exchanges of empties ordered each night by the wagon office in Paris.

Merchandise Department

Secondly, there is the Merchandise Department, which arranges division of receipts from merchandise. This is effected mainly upon a mileage basis, after the terminal charges for services at the arrival and departure stations have been deducted. In order to determine the correct proportions of the rate which has been charged on a wagon of goods from Harwich, let us say, to Aberystwyth, the Merchandise Department receives from Harwich monthly returns of the invoices relating to such interchange traffic, giving the weight of consignments and charges made. As a check on the departure invoices, similar lists are received from the receiving station. These two are compared at the Railway Clearing House, and all errors traced. This same method would apply to a wagon of goods sent from Harwich (L.N.E.R.) to Wrexham (L.N.E.R.) which travelled for any part of its journey over L.M.S.R. or G.W.R. metals. After the two returns have been checked, the respective Railway Companies' auditors receive a general certificate saying that the monthly total containing the invoice is correct or has been amended as necessary.

The division of goods receipts is effected in detail between any two stations where the charges reach a certain figure, the settlement of all freight traffic, including coal, mineral, and live stock being made half yearly with monthly payments on account. As a generalization, after terminal service allowances have been deducted, the remainder of the charges is divided propor-

tionately with the distance travelled on each line, but there are a great many exceptions which apply—for instance, special mileages are allowed for tunnels, bridges, etc., such as the Runcorn Bridge which is reckoned as 9 miles. About 350,000 divisions are made per half-year for charges of over £3 10*s*. per month. Light amounts, namely, monthly totals under £3 10*s*., are divided half-yearly by means of bulk divisions. These light totals number about 750,000 per month. The half-yearly divisions are based on the heavy amounts between the same pairs of Companies.

The Coaching Department

The Coaching Department which arranges the division of receipts from passenger traffic, deals also with the division of all through traffic carried on passenger trains ; monthly returns of passenger traffic being sent in by the Companies, separated into four sections, namely, ordinary (including tourist, week-end, etc.), excursions, workmen and season and traders' tickets. Above a certain value receipts are divided in detail, but passenger fares are divided usually in the proportion of mileage. Mileage is usually the basis for traders' and season tickets. Smaller amounts, which are known as the " Light Fund," are divided according to actual division of similar traffic for a selected basic month ; the railway passenger balance of accounts being notified to the Companies each month.

Parcels traffic receipts, as a result of the pre-paid stamping system, are now divided in bulk. Every station sends the Railway Clearing House each month a statement of the number of parcels received, the number of parcels despatched, and the value of stamps sold. The number of parcels and value of stamps are totalled, deductions are made for terminal services ; the resulting amount is divided according to an agreed formula. Division of receipts from the conveyance of Post Office parcels is made on an approximate basis each quarter, the exact division being made every six months partly in proportion to the gross earnings from the railway parcels traffic, and partly on the carriage of Post Office parcels.

The Railway Clearing House checks from time to time the Post Office accounts, to see that the latter are kept correct as to volume of mails carried by rail. Miscellaneous traffic by passenger train is dealt with in a similar manner to the merchandise traffic, the stations returns of forwarded, and received, traffic being checked and any errors discovered form the subject of inquiry. The Railway Clearing House is also responsible for the checking of tickets involving journeys covering more than one railway and these issued tickets are checked once a month.

If a railway does not pay its debts to other companies within the required period of, e.g., twenty-three days for merchandise traffic, it is charged interest on the sum in default, at a high rate of interest. The settled accounts are usually available about six weeks after the date to which they refer.

The cost of the work for each Company is recorded and an account made up for each Company each half-year, though interim payments are required on account. The Railway Companies pay in proportion to the work done for each, and the cost is the surprisingly low one of little over 1 per cent. of the settlements made between the companies.

Such is a description of the origin of the Railway Clearing House and its organization and method of working at the present time. Its action when first started was certainly as important as the repeal of the Corn Laws in 1846, for in the latter case the tax only affected the foreign imported grain and was only levied once, but a transfer from one wagon to another of grain, four times in a distance of 100 miles, was equivalent to levying a tax four times on home-grown grain. Its effect was very similar to a break of gauge, and in early history we read of much execration of the change of gauge at Gloucester. Thus, by the formation of the Railway Clearing House was made possible the territorial specialization of industry ; coal and iron ore in Durham ; shipbuilding on the Tyne and Clyde ; potato growing in Lincolnshire ; cotton in Lancashire ; and wool at Bradford. Doubtless some of these industries were established

in those places long before the coming of railways, but it was only as a result of through rates and fares that such industries could enlarge their markets and, in turn, reap the rewards of widened markets by increasing their own scope.

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CHAPTER VI

THE THEORY OF RATES AND FARES AND THEIR APPLICATION

In considering the methods by which a railway obtains its revenue, and the way in which each person or each ton of freight contributes its required quota, one has to bear in mind the original idea of transport charges as it existed at the coming of the locomotive railroad era. Earlier means of internal transport had been by means of turnpikes, or by means of canals, and in both of these cases the track or permanent way only was owned by the Company which built the means of transport. In the case of turnpikes, the toll-gates were erected so that money might be collected to repair the road and reward the capital with which it was built or improved. In the case of canals, the tolls were taken at the locks and were used for keeping the waterway in repair and affording a return on capital. Some Canal Companies certainly did run services with their own boats, but they appear to have been the exception rather than the rule.

Hence when railways were first built they were regarded from the same point of view; the construction Company was to own the permanent way and the users were to operate their own locomotive engines, coaches, and wagons upon it. Many coach bodies were built which could be adapted for running on railway axles and wheels. From the first it appears that our ancestors realized the difficulty of allowing each user to run his own engine, thus the Companies in nearly all cases began at once to supply the engine power or to contract out for its supply. However, private coaches were often run on early railways and even to-day there remains that relic of early Victorian days, the privately-owned wagon.

As a result of this origin of our railway system, the rates of to-day may be said to have two main component parts: firstly the charge of a toll for the use of the permanent way, and secondly the charge made for the actual haulage. Splitting up the actual rate itself later on into several other components, let us first consider the question of receipts to be earned as a whole. Revenue is derived from passenger and freight train traffic. Each must yield enough revenue to pay its fair share of total costs. When discussing expenditure it was seen to be almost impossible to discover how much the passenger service of a modern railway costs, but the answer necessarily turns upon our interpretation of the term "costs." There are direct costs and indirect costs, sometimes known as overhead or fixed charges. With a reasonable degree of accuracy one can discover the direct cost of a passenger service, which consists of the train locomotive and the carriage running and repair costs, including depreciation, interest charges on the capital expended on building the passenger station, and the wages to the passenger train staff.

So far one can be reasonably accurate, but beyond this the difficulties appear. Upon what sort of basis shall we apportion the district and divisional operating and commercial office expenses? Shall it be upon a basis of revenue earned by passenger and freight trains? Or upon a basis of traffic dealt with, assuming that one passenger equals one ton? How can one determine the extent to which rail wear is caused by passenger or freight trains? Is one to base signalmen's wages on the number of lever movements required by passenger and freight trains respectively? Or again, how is one to apportion the fuel consumption of branch line engines which do six passenger round trips per day and two freight train round trips? Finally, how can be allotted the share which passenger and freight traffic should be credited with to cover head office expenses, law charges, and pensions? It must be admitted that any approximate line of division will be very approximate in nature and largely based on assumption. The Interstate Com-

merce Commission in the United States has tried to lay down a rule by which expenses shall be so divided, but the results cannot as yet be claimed as an entire success. Admittedly costs should be worked out as far as possible so that a railway can know whether any of its traffic is being run at a heavy loss.

One can definitely state that no railway should continue to carry, over a long period of time, freight the revenue from which will not cover the direct prime costs of its own movement. Thus, the cost of service rendered, or, in other words, what the railway can afford to bear, does in actual practice fix the lower limit to any rate which a railway should quote. To induce new traffic, or to keep a factory open, which would otherwise have to close down, provides an exception to the rule. In the second of these cases it is possible that any loss involved by quoting a special low rate for the transport of a factory's product may be offset by the profit earned in carrying to it the raw materials for production.

Having discovered what fixes the lower limit of a freight rate, one may turn to the question of what fixes the higher limit. The maximum that can be charged for any service rendered is obviously the added value thereby caused. If coal is worth 15*s.* at the pit mouth in Nottinghamshire and will sell for no more than 25*s.* 6*d.* on the wagon at the railway coal depôt in London, then if the railway charges more than 10*s.* 6*d.* as a transport rate, coal will cease to travel in the same volume. The outer limit is, therefore, set by the increase in value given to the commodity. This has sometimes been termed as charging what the traffic will bear, but the phrase is distinctly ambiguous, as has been well pointed out in a case before the Interstate Commerce Commission.[1] It was there stated that " what the traffic will bear " may mean " all that the traffic will bear. If it means that the rate must be measured by the amount that the shipper is willing to pay under necessity, it is extortion. On the other hand, it may mean the least return for which the

[1] Commissioner Lane. Advance in Rates, Western Case, 20, I.C.C., 307, decided January 19th, 1911.

carrier can afford to transport the traffic. . . . To make rates for transportation based solely upon the ability of the shipper to pay those rates is to make the charge for transportation depend upon the cost of production rather than upon the cost of carriage—to measure public service by the economies practised by the private shipper. This necessarily gives to the carrier the right to measure the amount of profit which the shipper may make and fix its rate upon the traffic manager's judgment as to what profit he will be permitted. This theory entitles the railroad to enter the books of every enterprise which it serves and raise or lower rates without respect to its own earnings, but solely with respect to the earnings of those whose traffic it carries. This is not regulation of railroads by the nation, but regulation of the industries and the commerce of the country by the railroads."

Simple as the theory appears, it is always liable to misinterpretation, for in practice it is impossible for a rates expert to know what any individual traffic can bear. Even the trader often does not know until he experiments, what charges, whether it be railway rates or increased wage rates, his product can afford to pay. Yet whatever may be the failings of the phrase " what the traffic will bear " it is important as fixing a theoretical maximum which if disregarded would prevent the traffic from flowing. Unfortunately that maximum must remain theoretical unless found by actual test, but even in this latter case the condition is never obtained of other considerations being the same.

Between, therefore, the cost of service, which is what the railway can bear over a long period of time, and what the traffic can afford to bear lies the normal freight rate, but even the cost per unit figure is variable according to the volume of traffic which passes. Theoretically to obtain the maximum revenue the railway will so fix rates that the tonnage figure multiplied by the rate per ton will yield a maximum. Taking an isolated example, if 100 tons of a commodity were transported when the rate between two cities was 25*d*. per ton, the total revenue would equal 2,500*d*. Perhaps 150 tons would travel if

the rate of 20*d*. per ton was charged, in which case the total receipt would be 3,000*d*. On the other hand, if 30*d*. was charged, let us say, only 80 tons would travel, in which case the total receipt would only amount to 2,400*d*. It must be clear as to which would be the correct rate for the railway to charge of the three : obviously the 20*d*. one, provided the cost of movement in each case be the same. This is shown graphically in Fig. 8.

Consequently, one may venture to word the rule of rate-making as follows. The lower limit of a rate should normally be the direct cost of moving the commodity, and the upper limit must be set by the added value

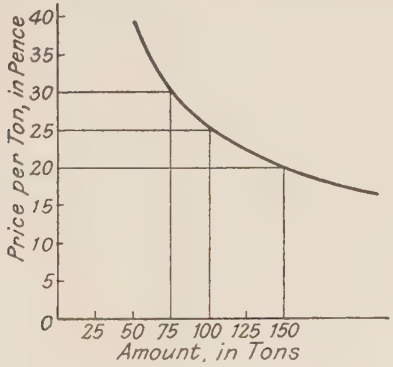

Fig. 8.

given to the commodity by the transport service ; between these two limits rates should be so fixed as to yield a maximum net value. In actual practice this is what a monopoly does, and in many cases in spite of road competition the railway does still possess the essential characteristics of a partial monopoly in that it does still possess power to control the price.

Such is the theory of the individual rate. The next problem is how to make each individual consignment pay its fair share, keeping in view the impossibility of dividing costs accurately between passenger and freight traffic. How much more difficult it is to divide it between the fifty wagons on any freight train between London, say, and Liverpool. The cost of the haulage

of the brake van must be spread over all the other forty-nine. Cost must be based on the round trip and, hence, the coal sent to London has presumably paid for the return trip of the coal wagon back to Staffordshire. If a hot box occurs, thereby increasing the cost through delays, it was unexpected and must come out of surplus profit elsewhere.

The basis on which payment is made is the Freight Classification. From earliest railway history there has been a division of commodities into different classes for the reason that certain articles can afford to pay a higher charge for transport than can others. Generally speaking the higher the exchange value of a commodity the higher the rate it can afford to pay for movement. The wealth of the Orient in the form of precious metals and spices, even in mediaeval times, could afford to pay the enormous costs of transport to the wealthy cities of Europe. Venetian prosperity was largely achieved through the barter and exchange of these precious consignments from the East. Coal, sand, manure, and gravel cannot afford to pay such high rates as articles of greater exchange value, and the principle adopted by the railways as regards their tolls, like those of the canals before them, the customs duties of nations and cities, and even of the early ocean shipowners, preserves this principle. The following are some of the considerations to be taken into account when classing any commodity to be transported :—

(1) Exchange value ; thus, silk will bear a higher rate than calico, gold a higher rate than silver, and manganese ore a higher rate than iron ore.

(2) Cost of the transport service ; with which is closely connected ability to load well ; for commodities, such as hay, which are difficult to pack, one finds that the rate differs according to the method of packing.

(3) Volume and weight of commodity : the nearer the tonnage or volume of a commodity approaches the wagon capacity, the cheaper it is to transport. Great Britain is almost the only country which does not adjust the rate scale mainly in accordance with the wagon capacity.

(4) Perishable goods; thus, fish and meat need a speedy service, while bananas require special vans and an even temperature.

(5) Method of packing.

(6) Regularity of traffic.

(7) Size of consignment; for instance, train loads.

(8) Owner's or Company's risk.

(9) Dangerous traffic, such as gunpowder or naphtha.

The present classification of all commodities which move by rail may be found in the General Railway Classification of Goods by Merchandise Trains, a new edition of which was published by the Railway Clearing House in January, 1928, and represents the gradual evolution of freight classification over a hundred years. The earliest railways in Great Britain were mainly designed for the transport of commodities of low value, such as coal, and consequently the number of classes which appeared in the early Railway Acts was very few, in the case of the Liverpool and Manchester Railway there being five; but as was natural with the early lines so widely scattered and carrying different types of commodities the classes and the commodities they covered varied considerably. It was not until the last thirteen years of the nineteenth century that any really notable progress was made towards the simplification of the classifications, but by 1892 this desirable and most necessary improvement had been brought about, mainly as a result of the passing of the Railway and Canal Traffic Act four years previously. It must not be thought that such a step had not been suggested before, but what now seems to us a naturally progressive step had failed to impress our forefathers similarly. From year to year as new products of industry call for transport service they become added to the classification; in recent years automobiles, their spare and component parts, telephone and radio apparatus, have been perhaps responsible for some of the most important additions. With the object of reducing as far as possible the number of exceptional rates, the latest classification (Table VIII) has increased the number of classes from eight, namely,

A, B, C, 1, 2, 3, 4, 5, to twenty-one new classes, the following table showing approximately how the older classes have been converted and extended into the new classes.

TABLE VIII

Old Classification. Class.	New Classification. Class.
A	1
	2[1]
B	3
	4
	5
	6[1]
C	7
	8
	9
	10[1]
1	11
	12
	13[1]
2	14
	15
	16[1]
3	17
	18[1]
4	19
5	20
Special and Small Parcels	21

Under the old classification, abolished from January 1st, 1928, coal and coke formed the bulk of the traffic moving in Class A, stone of many classes came under Class B, and much agricultural bulk produce, such as hay, in Class C. The A and B classes carried, generally speaking, a minimum tonnage of 4 tons, whilst C carried a 2-ton minimum, but these rates were of a station-to-station order, and included no more than the true haulage rate.

[1] Existing classification equivalents ; remainder are sub-classes to cover exceptional tariffs. The standard charges for conveyance and terminals are shown in Appendix I.

The next lowest scale to C was the No. 1 class rate, No. 5 being the most expensive class rate, but highest of all was the scale of rates for small consignments of under 3 cwt., which entailed heavy cost of movement owing to the necessity for their frequent handling and re-handling or transhipment. Many commodities appeared under more than one class, dependent upon the condition of packing, of which hay was, perhaps, one of the most noted examples. Hydraulic or steam-press packed hay being placed under Class C, machine pressed with a minimum of 2½ tons per wagon was also Class C, but machine pressed and a minimum of 2 tons per wagon had to pay a Class 1 rate, and with a minimum of 1½ tons a Class 2 rate. This difference clearly demonstrates variation in the cost of handling, but its near neighbour in the classification, helmets, shows the equally important differences due to variations in exchange value. Thus felt helmets used to pay a Class 4 rate, and the more democratic metal helmets only Class 3. Under the new classification felt helmets pay the Class 19 rate, the metal helmets now being termed " hardware, i.e. metalware, not gold or silver plated," and if made of " brass, bronze, copper, iron, or steel, or iron or steel galvanized, tinned, or enamelled," are still more democratic than their felt brothers and pay a Class 18 rate, but if " made of aluminium, aluminium alloy, Britannia metal, nickel, nickel copper alloy, nickel copper zinc alloy, or pewter," now achieve the same distinction as their felt brothers and must pay a Class 19 rate. These examples, it is hoped, will demonstrate the general principle of the freight classification.

To-day Classes 1 to 6 are applicable to consignments of 6 tons and upwards, smaller consignments of 4 tons and upwards to 6 tons paying Class 7 rates, those of 2 tons and up to 4 tons Class 10 rates, and those of less than 2 tons Class 12 rates. Classes 7, 8, 9 are applicable to consignments of 4 tons and upwards, but if of 2 tons and under 4 tons Class 10 rates apply, and when less than 2 tons Class 12. Classes 10 and 11 are applicable to consignments of 2 tons and upwards, whilst Classes

12 to 21 are applicable to consignments of any weight. For operating efficiency and reduction of cost, the best unit of movement in this country is the wagon with an average tonnage capacity of about 10½ tons and a cubic capacity which is never known, and is not even marked upon it. It is a matter for surprise that, when the more scientific re-classification was attempted so little attention was paid to this somewhat obvious anomaly in our rail charges.

A separate publication gives the classification of dangerous goods by merchandise trains. The conditions of carriage are set out under the Standard Terms and Conditions of Carriage by Merchandise Trains as passed by the Railway Rates Tribunal prior to the "Appointed Day."

One may now turn to a consideration of what the scale of rates itself consists of. If tea is bought from a grocer the price is quoted at x shillings per pound, silk, calico, serge, or linen, is so much per yard. The railway charge is quoted similarly at x pence per ton per mile, and as the silk, calico, serge, or linen may be P, Q, R or S shillings per yard, so the railway rate for four classes of traffic may be P, Q, R or S shillings per ton for the varying distances. On the American railways rates are normally quoted in cents per 100 lb.

For the charges on coal in the early Railway Acts one may find set out the maximum charges to be made by the Companies concerned, almost invariably phrased in terms of pence per ton per mile. The principle of equal mileage charges for each mile raises many difficulties for the transport organization as well as the producer suffering through greater distance from the consumer than his competitor. The producer's troubles are shared by the railway in that the former limit the amount of traffic carried by the latter, and it may well be that the railway, when offering a lower rate to the producer suffering disadvantages through distance, can legitimately claim that the added traffic thereby obtained will make possible slightly reduced rates for the producer nearer the consuming point, who, through the natural advantages he

enjoys, has been the original, if unwitting, cause of the lowered rate. Such cases in many different forms have occurred in all countries served by railways. The consequent result of this natural tendency to spread the overhead costs of a railway over as great a volume of passengers and freight as possible, results in the somewhat lower rate per mile for the more distant competitor, and plotted in graphic form one obtains the well-known tapering rate structure.

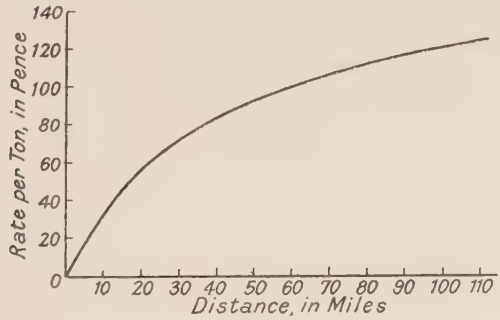

Fig. 9.

Taking a random scale from the "Scales of Standard Charges for Merchandise (other than Coal class) by Merchandise Trains," the effect of this decrease in the conveyance rate per ton per mile will be seen at once.[1] Thus :—

	10 miles.	30 miles.	60 miles.	120 miles.	240 miles.
Class 14 . . .	10/8	17/0	24/6	37/3	58/9

These are quotations per ton in Railway Companies' wagons. Hence, although the rate will be the same in the case of a journey commencing in London, Cardiff, or Liverpool, the charge per ton will in each case change as the distance of the journey increases. It would be difficult to overstress the importance of this principle which enables producer A situated further from a seaport, for instance, to mitigate somewhat the disadvantage of his position as compared with his competitor B, with

[1] Since the "Appointed Day" all rates are disintegrated into terminal and conveyance charges.

a factory only a few miles from the port, or other centre of demand for his products. Cheaper fuel or greater natural resources may help to offset all of B's advantages, but it is certain that in many cases if this principle had not been adopted the amount of production would have been seriously curtailed, which in its turn leads to less competition and higher prices. The effect of such a policy on the decentralization of cities, land values, town-planning and the distribution of population, as well as the development of natural resources obviously cannot be more than mentioned here, but opens up an immense field of thought as well as demonstrating the close relationship of rates policies to national and social welfare.

At first sight it would appear fair and just to charge the same rate for 5 tons of grain, let us say, when transported 100 miles north, south, or south-westwards, from a port such as Liverpool. In most cases this is actually done. One finds on looking up rate scales in nearly every country, that there is a rate quoted for a certain tonnage of grain a definite mileage. If one studies the case more closely, is it really as fair as it seems? To take the case first mentioned. From Liverpool northwards to Carlisle, a distance of about 100 miles, the grain must be lifted over Shap and Grayrigg summits, an expensive proposition. Equal mileage scales take no notice of gradients. Nor do they notice difficulties of operation, such as many junctions and congested lines with a high density of traffic. Southwards from Liverpool to Rugby, the line is much easier, it cost less to build, much of it is four-tracked and over level country; if equal rates are charged then the profit on one will tend to subsidize the other. Obviously this is not an ideal system of charging, it does not bear a very close resemblance to the cost minimum. Yet, if the differences are large the trader will complain that although mileage is equal various rates are charged, and he is the sufferer from discrimination.

On the whole equal mileages are charged equal rates, and this is true of the rate structures in almost every country. Certain stretches of line which have cost very

large sums to construct, such as the Severn Tunnel, the Forth Bridge, and the bridge over the Mersey at Runcorn are calculated as being equivalent to several miles. These cases are, however, exceptional and for simplicity the general practice is to charge equal rates for equal mileage and to allow the profit on one charge to subsidize the small profit, or even loss, on the other charge. Here, perhaps, is obtained one of those advantages of amalgamation which is hardly ever remembered. Since the " Appointed Day " the tapering scale with increasing mileage operates irrespective of railway frontiers, thus embodying the system of continuous mileage.

The British rate structure is, probably, in conjunction with the American, the most complicated of its kind. In part this is mainly due to a long coastline, numerous ports, and an important proportion of trade which comes under the category of foreign. In part it is also due to lack of system which characterized early British railway construction. Water competition mainly of a coastwise nature ever since railways were first constructed, has demonstrated its importance by successfully preventing the setting up of a system based entirely upon principles. The hundreds of small railways provided conditions of market competition to an infinite degree, and as a consequence superimposed upon the mileage scales endless so-called exceptional rates. These were designed solely to increase the volume of traffic flow and, therefore, were probably desirable if viewed from the point of view of the consumer. They enabled producers to rise above the margin of productivity without which aid these producers could not exist.

Estimates of the percentage of total traffic measured by tonnage travelling under exceptional rates prior to the " Appointed Day," namely, January 1st, 1928, usually hovered about 80 per cent., but the figure was undoubtedly much greater in the case of mineral traffic. Whilst it is too early to judge with what success the new classification has reduced this percentage, it is probable that the improvement falls very far short of the expectations originally held in this respect. From the railway point of view

the existence of these multitudinous exceptional rates is highly undesirable as long as the science of costing is still in its present state, but such disadvantages are to some extent offset by the added development of the country's resources, in which prosperity the railways must share and the increased volume of traffic handled has without doubt widened the base which must carry those overhead charges which in their turn form such a high proportion of a railway's total annual expenses. The practice becomes socially vicious if the movement is conducted at less than direct cost, since it must in this case be subsidized from other traffics, yet the entry into this theme of thought opens up the whole wide arena of the desirability of subsidy in any form. How is one to draw a line between the following cases: that of raw material carried at a loss to a works, the product of which can pay sufficient railway charges to offset the earlier deficit, the fabrication of the product, moreover, requiring movement of fuel to the works being carried at a profit; and that of traffic carried wholly at a loss yet offset by the surplus profits derived from some other traffic.

To-day with such an important percentage of our trade of the international type, rate divisions are of extreme importance and their complexity increases with the growth of trade. A railway rate regulatory body, such as the Interstate Commerce Commission or the Railway Rates Tribunal, has only jurisdiction within its own territory, yet how can it ignore the fact that a railway grain rate may be merely one small link in a long chain stretching from Saskatoon to London, or in the case of wool from Australia to Bradford. Ocean rates are fixed almost entirely by supply and demand and may frequently upset the route of a product by thousands of miles, cutting out ports and railway routes, whilst no redress is possible. The increase of rates on imported Belgian pig iron for a British steel works may quite easily raise the price of bridge construction in Africa to such an extent that the British tenderer has no chance compared with his Continental competitor. In this case the Railway

Company concerned suffers through loss of traffic, not only as regards the pig iron, but also as regards the product, steel, the lowered fuel consumption, and probably lowered demand for general goods and merchandise as well as for passenger facilities through the increase in unemployment. Here one has stumbled upon a vicious circle, and one which is hardly a question to be dealt with from the point of view of rates theory, provided that it is understood that changes in rates are no longer local in their effect; they are world-wide in their reactions and are fraught with grave consequences for society.

A further principle of rate-making has been hitherto unmentioned, namely, that of undue preference. Charges must be the same to all purchasers of transport services provided the conditions under which the service is rendered are the same. It is a commonplace to remark that while a merchant sells goods, a doctor, a lawyer, and a railway sell services. Such is true, but the methods of charging employed by the doctor and the lawyer as compared with the railway are very different. A doctor often charges in accordance with the wealth of his patient, a railway may not; the Railway and Canal Commission set up in 1873 is responsible for the prevention of undue preference between the users of the railway's transport services, although the principle had been adopted in an Act of Parliament [1] more than twenty years earlier. As a guarantee of the amount to be charged railway rate books are available for inspection at any railway station, and in addition to the standard rate scales there must also be available for inspection the exceptional rates from that station.

Before the "Appointed Day" the rates could be divided into two main classes, those quoted from station to station, and commonly termed S to S, and those known as C and D rates which included collection and delivery service. It should be remembered that the haulage charge and the collection and delivery charge, did not alone form the total rate charge, for in addition there were the station terminals at each end to be charged

[1] Railway and Canal Traffic Act, 1854.

for, the loading, unloading, covering and uncovering, the last four being known under the collective term of service terminals. From the beginning of 1928 all rates are station-to-station rates in the sense that collection and delivery charges are quoted separately and definitely split off from the haulage charge, the trader notifying the railway if he intends to employ the railway cartage service, or to utilize his own vehicles or those of a contractor. It is as yet too early to see the effect of this important change in the composition of the freight rate.

Up to the end of 1927 the maxima charges as set out by the Acts of Parliament in 1891 and 1892 ruled both the maxima rates for conveyance as well as the maxima charges for terminals, but these ceased to apply from the beginning of 1928. With the old A and B classes service terminal charges did not arise as these scales were quoted purely on the station-to-station basis, the traffic being loaded or off-loaded by the trader. Under the new dispensation the Classes 1 to 3 are quoted for owners' wagons whilst the station terminal at each end rises from 3*d*. per ton in the case of Class 1 traffic to 2*s*. 5*d*. in the case of Class 20. As regards service terminal charges, covering and uncovering does not arise for Classes 1 to 6 inclusive, or loading and unloading for Classes 1 to 10.

It is apparent that the rate charged is a component of several different charges, and only a portion of it varies with the distance traversed, hence the shorter the distance the greater will be the percentage of the flat charges for station and service terminals to the total rate. This is a second and most important additional cause which tends to the production of a tapering rate structure. It also forms a partial explanation of the vulnerability of short haul rail traffic to the competition of the road haulier who, by offering a door-to-door service, largely eliminates the costs represented by station and service terminal charges.

Section 52 of the Railways Act, 1921, permits the standard charge for merchandise by the shortest route to apply also to a longer route, provided such a route is not circuitous in order to retain competition on an

effective scale between two centres of population served by more than one railway route. The term " circuitous route " is defined as one being longer by 30 per cent. than the shortest route, and in such a case definite approval must be obtained from the Railway Rates Tribunal before the charge based on the shortest route can apply. Over 90,500 circuitous routes were scheduled by the four groups for submission to the Railway Rates Tribunal, and were approved, in addition to more than 20,000 by the remaining joint lines and the Metropolitan Railway. It is doubtful if the use of these alternative routes is not a cause of some of the complaints of long transit times which from time to time appear in the Press. High Wycombe to Birmingham through Woodford must entail extra time as does freight traffic from Bristol to London through Northampton or Bedford. Competition to such an extent is socially undesirable. The position is not so serious as in the United States, with its enormous area and with its well-known 4th Section relief problem which makes an exception of the rule that a higher charge cannot be made for a shorter distance than for a longer distance over the same route, but nevertheless the position in Great Britain is sufficiently severe to warrant close attention.

A bibliography is appended to the following chapter.

CHAPTER VII

THE THEORY OF RATES AND FARES AND THEIR APPLICATION (*contd.*)

Having seen how the charge per ton per mile varies in the case of freight movement, one may with advantage contrast that principle with the fares charged in the case of passenger traffic. As in the case of freight traffic the maxima charges were fixed on a per mile basis in the early Railway Acts, the equal mileage system obtaining as a general principle. With the coming of the Parliamentary trains, permitting access at least once a day to every passenger station by the payment of a third-class fare which in the vast majority of cases was based on a charge of one penny per mile, the equal mileage basis became still further stabilized, and to-day the rate of 1·5 pence [1] per mile may be regarded as the standard fare for the four big Railway Companies. The first-class fare of 2·5 pence [1] per mile as compared with the pre-war charge of approximately 2 pence [2] may also be regarded as the standard fare, whilst the intermediate second class, on a basis of 2·0 pence [1] per mile, has suffered almost entire eclipse except upon the suburban lines in the north-eastern suburbs of London, where in certain cases the third-class fares are well below the average, and on certain continental train services, made necessary in this latter case by the provision of second-class carriages on the services provided on foreign railways. It must be remembered that there is a railway passenger duty the proceeds of

[1] The basis authorized by the Railway Rates Tribunal and used by the Railway Companies since the reduction on January 1st, 1923.

[2] The pre-war first-class fare varied from 1·58 to 2·21 pence.

which amounted to over £400,000 in 1925–6, the greater portion being derived from first-class passenger travel.

Study of passenger fare scales will show practically no evidence of the tapering characteristic so general with freight rates, and it may well be asked as to how this difference has arisen. Graphically (Fig. 10) one obtains a straight line in the vast majority of cases, although exceptions and anomalies may be found here and there.

In the past it has been the custom to regard passenger traffic as comparatively inelastic, that is to say, its value varied comparatively slightly as a result of decreases or

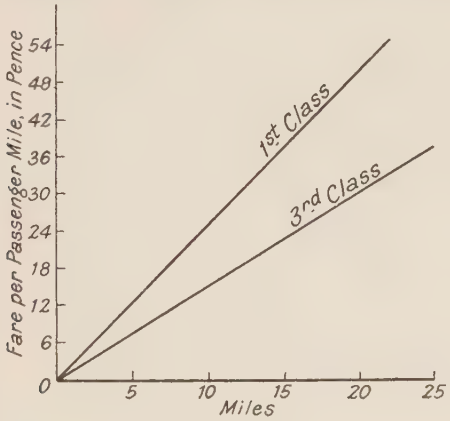

Fig. 10.

increases in the level of passenger fares. Such may have been the case in the past, when motor vehicle travel had not been widely developed, and before the railways had been deprived of their virtual monopoly in passenger travel, but signs are not wanting to-day that passenger travel now possesses to a large extent the nature of a luxury, and, consequently, becomes, to a similar degree, elastic. The demand for most luxuries is often highly elastic, and the railways have endeavoured to meet this new aspect of passenger travel by offering cheap fares upon certain days of the week at very low rates. The seriousness of this problem will be realized when it is stated that only 50 per cent. of total passengers carried

in 1926 paid the standard fare. It may be that such a policy is justified as a means of preserving traffic from a highway competitor, but it is reasonable to suppose that many who would have travelled by ordinary fare availed themselves of the opportunity to travel on the days when cheap tickets are available, thus reducing railway revenue. On the other hand, many possibly travel who would not otherwise have done so at all, and full train loads enable the cost to be spread better and so permit low charges per unit.

The adoption of an equal mileage scale for passenger traffic is also based upon a further conception. In the case of freight traffic it has been explained that terminal charges often form a large proportion of the total charge and, as the length of mileage increases, this proportion will naturally tend to fall, consequently one obtains from this source the reason in part for a tapering scale. The counterpart of this feature in the case of passenger traffic is not so noticeable, although to maintain its non-existence would be equally incorrect. Truly the passenger loads and unloads himself, with few exceptions, and objects to being handled, but, nevertheless, there are other elements of cost which may legitimately be regarded as passenger terminal costs. Interest on capital cost of a station like Waterloo, the Grand Central in New York, or Leipzig, is obviously a very large sum, whilst a large staff must be required to assist the passenger's movement, unload his luggage, issue and collect his ticket, answer his inquiries, and look after his comfort. To a certain extent these auxiliary services are paid for by the passenger, by tipping he augments somewhat a porter's wages, he pays for refreshments, and so forth, but the passenger, who uses the facilities of a large and conveniently positioned station, does not pay specifically for the interest on capital investment in Great Britain. Abroad he does do so, in many cases, in the form of a small surtax.

Thus, it comes about that the element of terminal charges does not normally enter into a passenger fare scale ; his payment is a haulage rate only, and, at present,

based on the equal mileage principle. If a flat rate were to be charged for the use of a station like Waterloo, or Liverpool Street, its incidence would fall particularly heavily upon the short distance passenger, and it is just this class of passenger who to-day is so largely transferring his patronage to other means of transport. Such movements work in cycles, and as soon as road movements to and from the suburbs become slowed up to a still greater extent, owing to road congestion, a reversion to travel by rail will naturally occur. The greater accelerative power of electric traction has done much to retain urban traffic to the railways, but it is difficult to segregate figures so that one may know to what extent such a policy results in profits. It is the social duty of a Railway Company to concentrate upon those transport services in which it enjoys the greatest advantage over other means of transport, for the same reason that a country's industries should concentrate on those in which it excels over its neighbours.

Returning once more to consider the mileage principle, its relationship to cost is important. It is popularly supposed that haulage costs per mile decrease as the distance increases, even if the terminal charges be eliminated from the discussion altogether. If such be the case its results are far reaching, for therein is a certain justification for the tapering scale, also it would seem to point to the fact that rates will be lower per ton mile in areas where the haul is long. In a study of foreign trade such a consideration is of paramount importance. On what facts, however, does such a supposition rest ? Much of the cost of haulage by rail consists in forming, and reforming, the train, as well as in the collection and delivery of the wagons either from privately-owned sidings, or from the various freight stations and coal depôts of a large city. In the large cities only can a train be formed wholly, and despatched directly, from one siding or freight station.

The costs of running upon the main line will vary according to the congestion of that line, the number of stops, either for signals, or detaching, or picking up

wagons, but it is safe to assume that the first 40 miles of a through freight train's run after formation will not exceed the cost of collecting the wagons for that train from several depôts, and placing them in correct formation. Consequently, it would appear that there is considerable truth in the supposition that costs per ton per mile do actually decrease as mileage increases; on the other hand, it is easy to overstress this point, for it is doubtful if the cost progressively changes to an important degree after a haul of 100 miles. Train inspection, reformation, and other causes tend to offset the reductions in per mile cost previously referred to.

There must be many cases where, owing to track layout, variations in gradients, and so forth, it is actually cheaper to run a wagon 100 miles than 50 miles; especially would this be the case when the latter represented a movement from the terminal station of one branch to the terminal station of another branch, or in congested areas where the freight train would have to be placed in refuge loops or sidings for long periods of time. Like so many railway problems it is extremely difficult to design a general ruling to cover more than a single isolated case. No two railway lines are the same, their traffic differs from day to day, varying weather conditions may easily make important differences in costs; all that one can do is to stress the importance of the element of terminal costs in any freight rate structure. The American system of switching or shunting charges per freight car in city areas, or at transfer points between railways, makes some attempt to segregate these from the line haul charge, but such cases are practically nonexistent on a similar basis in this country.

Such a method, often based upon the zone principle, logically brings us to a consideration of this latter type of rating basis, closely connected with which is the principle adopted on one of the early tube railways in London, of charging a uniform fare of 2*d*. between any two stations. This latter method tends to induce the short distance passenger to walk short distances or utilize other means of transport, but it is a method almost

universally employed for street railways and tramways in the United States, and is also employed on the subways of New York City. Its advantages lie in the inducement it affords to decentralization of population, permitting the less well-to-do to live as far from the centres of daily work as possible, but whilst socially desirable in this respect it often fails to ensure an adequate revenue to bolster up the credit of the organization sufficiently to make certain a steady inflow of new capital. Its commonest application is in the case of the postal services, but it is here made possible by the fact that in every country the letter postal services are a Government monopoly, and alternative means of sending letters

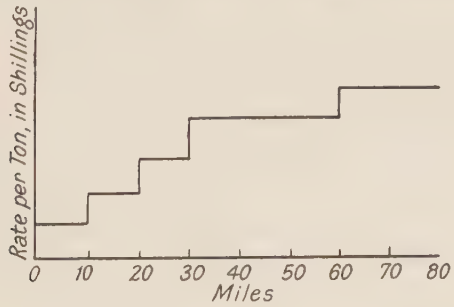

Fig. 11.

short distances are, consequently, not available. The zone scale, if applied graphically, takes a formation somewhat as shown in Fig. 11.

In Great Britain this system of charging is employed in the case of rates on parcels, which travel by passenger train, and is common in the United States as a basis of freight rate scales, notably in Rocky Mountain and Pacific Coast territory, and for large areas in the Middle Western States, as well as in the famous Texas Common Point case. Usually known as the blanket system of rate-making it tends to equalize the competition between districts covering wide areas, themselves far distant from either the producer or the marketing point to which goods are despatched. The area of Great Britain is too small, even taken as a whole, to permit the application

of such a method in extenso, and for ordinary freight traffic has held comparatively little sway over the general structure of British rates. This latter, so inextricably dovetailed into ocean or sea rates, is mainly guided by purely competitive considerations, which also accounts for the huge proportion of traffic handled at exceptional or special rates. The reasons for granting such are manifold, but let us take two cases. Suppose a large works has obtained a contract in the face of fierce foreign competition and requires to ship 14,000 tons of rails to some such port as Liverpool, Middlesbrough or Swansea, for shipment to Buenos Ayres. With regular shipments of, let us say, 300 tons at a time, which can be run as a train load, no shunting *en route* and other advantages, it may well pay the steel company and the railway to come to an agreement regarding a special rate, it may be even a temporary rate to cover this special contract.

One has to bear in mind that not only will the railway benefit by this traffic, but also the extra wages earned may be spent on travel and on obtaining a better standard of living, whether this be measured by gramophones, pianos, whippets, higher grade food, or cinemas. Then the added contract will enable other steel to be produced more cheaply, and thus other contracts may be obtained. Finally, the raw material which goes to make up the product will largely be handled by the railway, thus adding considerably to the railway income.

A second case might occur as follows: An artificial silk company, or a brick-making concern, might come to the railway and say, "We want to put up a factory (or brickyard) on your line at K, but we find the normal standard rate will in all probability prevent our extension from being a success; will you quote us an exceptional rate based on our estimated regular output?" With coal-mines this kind of position is almost the invariable rule, for over 90 per cent. of coal probably moves on exceptional rates.

Theoretically this exceptional rate would be based almost entirely upon the consideration of obtaining the traffic, but in practice this is not always or even often

the actual case. Firstly, full particulars must be obtained of likely output, and direction of the traffic. Secondly, one must find out as nearly as possible what the actual cost of handling the traffic will be. Thirdly, one must see how it will affect other similar rates in use to or from other neighbouring points. Fourthly, one must study the question of market competition.

Suppose the exceptional rate is asked for from A to D (Fig. 12). If exceptional rates exist for the same traffic to B, C and E, obviously the rate from A to D must bear some relationship to them. If AB costs 10*s.*, AC 10*s.* 3*d.*, and AE 11*s.* 6*d.*, AD might be placed at 10*s.* 6*d.* Then towns such as A_1 and A_2 must be considered and

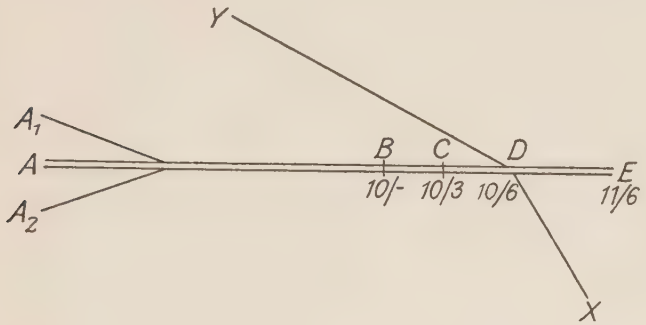

Fig. 12.

their claims to exceptional rates. Lastly, there is the question of market competition. If Y and X already produce the articles which A is intending to produce, the railway must determine whether it is desirable to have Y and X traffic damaged by A's proposed competition. If X and Y are served by another railway, probably less consideration will be given to their prosperity, but if by the railway running from A to E, then obviously it will foster the business from which it obtains a higher freight rate.

Whilst the Railways Act of 1921 definitely aimed at reducing as far as possible the number of exceptional rates, it has been proved that such a far-reaching proposal, however desirable, if carried out ruthlessly would

totally disorganize, at any rate temporarily, large sections of British industry.

An important feature of the British freight rate structure prior to the "Appointed Day" was that known as the owners' risk rates. The general theory underlying owners' risk rates was the idea that a railway could afford to offer a lower rate for certain articles provided they were accepted on the condition that no claims for damage would be made against the Company. Certain goods of a highly breakable or fragile character were only accepted under such conditions, but in many cases the trader was free to choose as to whether to send his goods at a low rate at his own risk or at a higher rate at the Company's risk. Theoretically the difference in rates charged was equal to the risks which from practice were found to be taken by the Railway Company when accepting the obligation to transport. In the General Railway Classification the owners' risk rates were known as x, y and z, carrying reductions of 10, 15 and 20 per cent. respectively. Thus, school requisites in the old General Classification are placed as $3y$, which means that they carried a 15 per cent. reduction on the third-class rate. Consequently, in theory the 15 per cent. should be the amount which in practice the railways have found that they can afford to offer to eliminate the risks of breakage, or loss, during transit.

In reality these reductions often bore little resemblance to the actual losses experienced, and the owners' risk rates, with reductions of 10, 15 and 20 per cent., came to be looked upon as a good medium for bargaining between the trader and the railway. Thus, if a trader on the one hand maintained that a certain commodity should really be classified as Class 1, while the railway maintained on the other hand, that it should be classified as Class 2, after considerable argument and bargaining it often resulted in the railway suggesting a $2y$ rate, which was 15 per cent. below the Class 2 rate and yet was somewhat above the Class 1 rate.

Summing up one can say that x, y and z in the classification gave to commodities conveyed at owners' risk a

lowered class rate, thus in practice offering a greater number of classes. Fittings for shops and offices were given as Class $4y$, in which y theoretically is equal to the cost of liability, but it is hard to see how damage amounted to 15 per cent. in such a case as this. It is true to say that the margin of risk of a Railway Company on all traffic carried is very small. As a consequence the Railways Act of 1921 (Clause 46, para. 3) stated that "the margin of risk shall be equivalent to the amount by which the risk of the company in the case of the merchandise in question differs under the two sets of conditions." Consequently, the arrival of the "Appointed Day" has, in this case, brought practice more closely into line with theory, and whilst the same method is employed the reductions to be made from the standard charges where damageable merchandise is carried by merchandise train under owners' risk conditions are very much smaller and stand as follows :—

Traffics marked	$a=2\frac{1}{2}$	per cent.		Traffics marked	$e=7\frac{1}{2}$	per cent.	
,,	,,	$b=3\frac{3}{4}$	,,	,,	,,	$f=8\frac{3}{4}$	,,
,,	,,	$c=5$	,,	,,	,,	$g=10$	,,
,,	,,	$d=6\frac{1}{4}$	,,	,,	,,	$h=12\frac{1}{2}$	,,

Apparently school requisites are no longer considered worthy of special attention and remain unmarked. Shop fittings, now camouflaged under the more grandiose title of fixtures, shop and office, without glass in parts, if consisting of common wood with hard wood facings, unfinished, part polished, are presumably liable to only $3\frac{3}{4}$ per cent. damage, for they are only marked as b. Fixtures, shop and office, however, classed as furniture, if easels, blackboards, or coal scuttles, are liable to $7\frac{1}{2}$ per cent. damage, but furniture, church, metal, lecterns, are apparently only damageable to 5 per cent.

The new scales are a very distinct improvement upon the old, and prevent to a large extent the element of bargaining hitherto so prevalent. A recent decision of the Railway Rates Tribunal laid down that the element of risk was so small in the case of traffic carried by passenger train that there was no real need after the "Appointed Day" to embody owners' risk scales for traffic moving

at the standard rate by passenger train, but a series of exceptional rates at the owner's risk have been arranged with the consent of the traders.[1]

Turning once more to a short study of passenger train traffic and the charges made for it, the equal mileage ordinary fares have already been the subject of discussion and it was pointed out that to-day half the number of passenger journeys are undertaken at less than ordinary fares. These reduced fares consist partially of certain cheap day, week-end, or holiday period tickets, but the large number of season tickets and workmen's tickets account for the main bulk of this cheap movement which resulted in an average revenue per passenger mile of only 0·8 pence in a recent month, when the average distance of the passenger journey was only 10 miles.

It is interesting to note that the theory underlying the issue of season tickets is exactly opposite to that of the tapering rates for freight. Thus, one might have thought that as large passenger terminals are expensive to construct and operate, a flat rate would have been charged for their use, which would have formed a larger percentage of a short distance fare than that of a long distance fare. Yet what actually takes place? A very cheap rate is given per mile to the person who uses the terminal often, and creates all the difficulties of "peak" traffic working. Nevertheless, the creation of season ticket rates was a wise one and one which can be very easily defended from the economic viewpoint. The season ticket holder, if not granted a special low rate, would very often take the alternative means of transport, trams, buses, or tubes. He is carried in set block trains, the vagaries of his hours are known, and though he tends to create congestion he does not normally require an elaborate service between rush hours; although recently to provide a use for rolling stock which must be available for rush-hour traffic, some railways have put into operation cheap mid-day fares.

[1] For milk the scale is about 10 per cent. below standard charges, newspapers 20 per cent., general parcels 30 per cent. to 40 per cent.

Although he pays a low rate per mile in most cases in this country, the season ticket holder is probably in actual practice carried at a profit, and thereby subscribes a little towards overhead costs, and towards the interest on the investment of the large station and general overhead charges. In other countries the suburban season ticket holder is not looked upon with favour by the railway authorities. In France, in recent years, it is the Paris season ticket holder who has been largely responsible for the operating deficit, which has been the most notable feature of French railway finance since 1921. This has been partly due to the fact that season ticket rates were not raised so much as ordinary passenger fares, and the French railways have been studying our London rates very closely of late. In America also the season ticket holder, or commuter, as he is called, has been carried until recently at a heavy loss to the railways, especially in the New York and Chicago areas. Lately on several lines, in spite of considerable outcry, season ticket rates have been raised. The suburban season ticket holder seems to have remarkable political power, and in Paris notably he raised the arguments which are always hard to contravert, since there is much truth in them, of the advantages of living in the healthy suburbs, thereby reducing the city housing crisis, and bringing up the babies in sunlight. It seems rather hard, however, that the railways should be the means of subsidizing health, the suburban landowners, or the babies, especially if they happen to be private Companies. Often, in fact, it is the other passenger traffic that really subsidizes the city worker who lives in the suburbs. Our own railways seem to have solved the outer suburban problem much better than have foreign railways, and actually encourage the city men to live in "healthy Highgate," "sleep and golf at Gidea Park," and "sun oneself at Southend."

Since the "Appointed Day" there has been a uniform scale of season tickets nominally in force, although in certain cases where such a scale would have meant very large increases they have not been raised to the full extent permitted, and practically no increase was put

into force which amounted to more than 10 per cent. Unquestionably the standardization of such a scale was desirable, however hardly it may hit certain communities in the first instance.

Trader's tickets can be dealt with more briefly. Here the underlying theory is that by using the railway frequently the trader will be able to so assist his business that the railway will obtain in return for granting a cheap ticket the additional prosperity and traffic which is bound to result from an increased industrial or agricultural activity in the area traversed and served by the Company. Such tickets used to be granted to traders whose traffic over the railway was of the carriage value of £450 per annum and upward with a minimum of £450 for each ticket issued. They were issued for twelve- or six-month periods. From the economic point of view it is doubtful if the trader's ticket system is beneficial. From the railway point of view possibly it is, but nationally and socially there is a strong danger of discrimination in favour of the large business. Provided the conditions are not abused there can be little objection made to the practice of trader's tickets, though admittedly they were first issed when rail transport held almost monopolistic sway, and the time may come when the conditions of trader's tickets may have to be revised, in view of the rise and strong competition from motor services. If the practice is abused, however, strong exception can be taken to it, and where competition is very great matters may come to a head. The Rates Tribunal fixed the scale of these tickets as being 25 per cent. below the standard ordinary season ticket rate.[1]

In a Western American State not so many years ago the issue of passes formed the subject of investigation, the system being employed widely to influence the routing of freight. Admittedly this was a step further than trader's tickets, and no railway was strong enough to stop the abuse, since it feared it would lose much of its traffic to its rivals. Where passenger traffic is very

[1] Before the " Appointed Day " the scale for these tickets was 42 per cent. below the ordinary season ticket rate.

light and the area is sparsely populated such considerations were paramount. As a result, the Federal Government at Washington passed legislation which forbade the issue of any passes to others than those actually employed by the railroads.

Workmen's fares were started in the year 1883 as a result of the Cheap Trains Act. This Act abolished the duty on passenger fares of one penny per mile, in return for which the railways ran cheap trains for workmen. The difficulty of determining who was, and who was not, a workman, proved a serious question to answer, and has recently been accentuated by the more or less universal eight-hour or nine-hour period between the crush hours. The result has been that the workmen's fares have become applicable to those travelling early in the morning, since the day for manual labour in this country is largely dependent upon daylight, and fortunately for transport companies finishes about an hour or two before offices close. Thus the rush morning and evening period is somewhat spread out.

The economic aspect of workmen's fares is primarily one of the full train load; in fact, that is the main principle underlying all reduced rates and fares. The social effect of workmen's fares is all-important with our modern city organization running at high pressure, which is bound to result in considerable strain on the individual, especially those to whom the weekly wage is at little more than subsistence level. The possibility of getting the worker into a cleaner atmosphere with more sunlight and less smoke, under better housing conditions, and the chance of possessing a good garden, which not only supplements the wage but also gives good exercise, are often only made practical by workmen's fares. A workman's return ticket for a journey not exceeding one mile costs 2*d*., a tapering scale being employed which reaches one farthing for every mile after the twentieth.

A further series of passenger fares to be mentioned is tourist and excursion fares. Here one arrives at a very different principle of charging, and one which bears out extremely well one of the main theories underlying

transport economics. At an earlier stage it was seen that transportation companies whether canals, tramways, or railways, and one might also add other public utility transport organizations such as gas, water, and electric supply companies, are involved in heavy capital cost before they can hope to earn any revenue. The revenue when it is earned is obtained by making a very small profit on a very large number of sales, whether of gas therms, passenger-miles, or gallons of water. Most of these undertakings are protected from violent competition by franchises; as a result their rates are regulated and their profits small, usually a fairly steady 4 to 8 per cent. The result is that their whole policy is to extend the number of their sales, get more gallons through their water main, get more passengers over their lines, sell more therms of gas, or more units of electric power. By this means they can spread their fixed costs or charges which remain almost stationary regardless of the amount of their sales. It may be asked how all this affects the policy of tourist and excursion fares: surely the connection is clear.

There are few railway lines to-day working at fullest capacity during the twenty-four hours. Now assuming that a line is not working at full capacity and that the limit seems to have been reached in obtaining new passenger traffic at the ordinary fares one might start an advertising campaign to obtain more traffic at full fares, but the extra expense of the campaign must be offset against increased passenger fares obtained. Sometimes, the added expenses may balance the added revenue. There is, then, the alternative of cheaper fares which can only be offered if the costs of running the trains are kept low, hence for excursions certain considerations should be kept in mind. For instance, trains must be fully loaded and with ingenuity crush period trains may be used. Thus on the Southern Railway suburban sets are used for race traffic. As far as possible excursion trains should leave cities as the rush hour arrives, or after it is over, and return when the rush hour traffic is leaving, thus saving empty passenger train mileage. Fares can be reduced

so as to just cover costs, though admittedly it is difficult to find out exactly what the costs involved will be.[1] Any traffic regained from the roads serves to raise the cost of overhead charges per unit to road hauliers, but will tend also to reduce it in the case of the railways, whilst prosperity brought by excursionists and tourists to the area served by the Company tends to increase the potential traffic to be carried. The case of Blackpool, the prosperity of which has been entirely made by railway enterprise, is appropriate and telling. With rolling stock as with a ship it is often cheaper to keep it running than to let it lie idle. Occasionally ships have been known to sail with ballast from South Africa to North America to load grain for England. The cost of running an extra train is not high, and if it contains a paying full load it should bring considerable net profit to the line. The rails will not be more seriously worn as a result, the signalmen will not be noticeably more tired, the District Superintendent will not be more greatly worried, although there are certain elements of added wear and tear, extra congestion which results if delay is caused to other trains, a certain amount of extra fuel consumed, and extra wages paid. In connection with the latter, overtime should, in a case of this kind, be especially avoided. In the spreading of overhead charges lies the main advantage of tourist and excursion fares. To-day as stated over 50 per cent. of passengers are carried at reduced fares, a result partly due to strong road competition.

Perhaps the most important traffic carried by passenger trains, other than passengers themselves, is mail traffic, and important economic considerations enter into this question, such as the effect of widespread dissemination of reliable news amongst the members of a nation. In Great Britain Post Office services are a Government monopoly, and in actual practice normally are self-supporting. Few better cases could be made out for running any service at a loss, which must mean in fact

[1] A recent case showed a charge of 10*s*. for a distance of 200 miles with non-stop trains in both directions and included two meals.

by subsidy, than that of mails and newspapers which ensures the spreading of correct news. A highly civilized nation without its newspaper service is utterly helpless, and a prey to rumours and false alarums as was amply proved during the short period of the General Strike in 1926. The arrival of broadcasting has, perhaps, modified slightly the importance of newspaper services, but the moulding of public opinion, the spread of cultured thought, the exposition of more than one side to any one question, alone permits the successful functioning of a modern democracy upon which to-day it is the fashion to pour undiluted scorn.

Letter mails are carried under the provisions of the Conveyance of Mails Act of August 14th, 1838, every railway being bound to accept all mails offered, the payment of such service being agreed or settled by arbitration. Post Office employees load and unload the mail bags. The railway must provide sorting carriages, the Post Office paying sufficient to cover the capital cost for their construction, maintenance, haulage and lighting. The Post Office pays season ticket rates for the sorters' fares, and exercises control over the running times of certain trains; if necessary special trains must be run at a certain rate per mile. The full ordinary parcel rate is charged for each bag, but from this an allowance of 25 per cent. has to be made for services not rendered, namely, handling and booking; then less 8 per cent. in respect of through bags, namely bags transferred from one Company to another at junction stations and then less 10 per cent. for quantity and regularity of traffic, which works out at a total deduction of 37·9 per cent. In 1925 the mails traffic brought in a total revenue to the four railways of nearly £1,750,000.

The Parcel Post traffic payment, which originated as a result of the Post Office (Parcels) Act 1882,[1] is divided

[1] Under the Parcel Post Act, 1882, "every Railway Company is bound to convey by any train by which passenger, goods, or parcels are conveyed, all such parcels as may be tendered for conveyance by such trains, whether such parcels be under the charge of persons appointed by the Postmaster-General or not,

between the railways partly on a certain percentage, namely, on the same percentage as the division of the Railway Companies' own parcels traffic, and partly on the basis of mail bags or baskets conveyed. To obtain this a week's check is taken yearly by the Post Office and the Railway Clearing House, on behalf of the railways. The Postmaster-General hands over an agreed percentage of all receipts derived from the parcels post. In the nineteenth century the percentage was somewhat higher than the present one, but recently much of this traffic has been handled by road motors owned by the Postmaster-General, or worked for him on a contract basis. Payments are made to the railways through the Clearing House quarterly. It is interesting to observe that in the United States, the Railway Express Companies, now amalgamated into the American Railway Express Company, were so efficient that no parcel post system was started there until 1913.

The present system is considerably more simple than at the time when the Post Office used to record details of all the parcels posted, the charges upon them, and their means of transport, for it merely necessitates the average postage charge per parcel for the week in question and the percentage of parcels carried by rail. The division of the revenue thus obtained by the Railway Clearing House from the Post Office was originally divided entirely in proportion to the revenue from each Company's own parcels traffic. It has been stated [1] that the number of

and notwithstanding that no notice has been given to the Company in respect of such parcels, provided that the conveyance of parcels by mail and express trains shall be limited so as not to affect prejudicially all reasonable facilities for the receipt and delivery of the sacks, hampers, etc., containing the parcels at any of their stations without requiring them to be booked or interposing any other delay and shall perform the service of transferring such sacks, hampers, etc., to and from the vehicles of the Postmaster-General at the outwards and inwards railway stations."

The Railway Companies receive 40 per cent. of the Postmaster-General's gross receipts from rail-borne parcels and the amount so received is divided between the Railway Companies.

[1] P. H. Price, The Railway Clearing House, *Institute of Transport Journal*, May, 1926.

rail-borne Post Office parcels reached the enormous total of 137 millions in 1925.

The railway parcels traffic scales have already been referred to briefly and are responsible for bringing in an important item of railway revenue. In connection with the division of the receipts from this traffic for which the Railway Clearing House is responsible there is operated a universal parcels stamp pool. Each station forwards particulars of parcels received for destinations on other railways, and gives details as to the stampage charge, together with details of the parcels received. The stamp pool operates on a fixed percentage basis for all parcels transferred from one Company to another in the course of their transit. Certain terminal charges are allowed for parcels traffic. A most interesting study may be made between the British railway and Post Office parcels rate scales and those of the American Post Office parcels and the American Railway Express organization,[1] but this hardly comes within the purview of this book.

There is much miscellaneous traffic also handled by passenger train, charged by weight when exceeding 2 cwt., but one of the most interesting is the transport of milk. Although not entirely a passenger train traffic, it must, owing to its perishable nature, be carried at high speeds and, where sufficient traffic permits, special trains composed of milk vans are run to such depôts as Finsbury Park, London and North Eastern Railway; Willesden, London, Midland and Scottish Railway; Paddington, Great Western Railway; and Clapham Junction, Southern Railway. No less than 91 million gallons of milk[2] were brought to London by rail in 1925, of which over 50 per cent. was carried by the G.W.R. The speed of many of these special milk trains is very high, thus the run from Westbury to London, a distance of 95½ miles, only occupies three hours, whilst the L.M.S.R. and

[1] Johnson and Van Metre, *Principles of Railroad Transportation.*

[2] *The Fluid Milk Market in England and Wales.* R. B. Forrester, Ministry of Agriculture and Fisheries, Economic Series, No. 16, 1927.

L.N.E.R. Companies offer fast services to London from the important milk-producing area of Staffordshire. Although figures are not yet available as to effect upon rates charged for milk resulting from the coming of the "Appointed Day," it is probable that such charges will not be materially different on the average from those applicable during 1927. For the whole country the charge was roughly 1·5 pence per gallon, which would point to an average haul of rather over 60 miles. On the long hauls the rate per gallon per mile falls in a tapering manner as with nearly all freight rate structures, thus on a haul of less than 40 miles one penny will carry a gallon for rather over 30 miles, but on a 150-mile haul one penny would carry a gallon for about 75 miles. A recent development has been the adoption of glass-lined tanks carrying 3,000 gallons in place of the 10-gallon and 17-gallon churns until a few months ago in universal employment. Such a system lowers very considerably the proportion of dead weight to be moved compared with revenue freight to be hauled.

A further feature of passenger train merchandise traffic is its seasonal nature. Much of the traffic sent by passenger train is in the nature of perishable goods and the demand for transport is thus bound to be seasonal. It is traffic which can afford to pay a high rate and from its perishable nature is bound to suffer heavily from road competition. From the economic point of view passenger train revenue is a complicated one to study, for one passenger train may be conveying passengers, first and third, letter mails, parcel mails, railway parcels, perishable traffic, and possibly excess luggage. In fact, it is almost as complicated as the classification of freight on a freight train. It is once again a question of joint costs ; the total revenue from all sources must cover the total cost of running the train, and it may be desirable to subsidize the most competitive type of traffic, confectionery, rabbits, game, and fruit, dogs which pay by the mile, and cats which are charged by the pound, by the extra profit made on carrying the first-class passenger. It is entirely an economic problem of costings. Should the

tourist ticket holder help to pay for the milk to feed London babies who cannot afford to see the beach at Clacton ?

The practice with regard to the rates offered for wagons to or from private sidings varies considerably between our railways and those of the Continent and America. Here it is the common practice to offer a lower rate to and from a private siding, and it is rather difficult to see why this practice should have arisen unless it be the idea that the terminal charges are not so heavy since the land upon which the private siding has been built is not railway property, and, in most cases, the trader has built the siding, the railway often charging for the cost of making the necessary connection. It will be seen that this theory allows nothing for the increased haulage costs often required to place wagons in a private siding. In many cases, private sidings are only served by trains going in one direction, thus, wagons for the private siding Z may often have to be hauled from A past K to B and back to K, and on departure may be hauled from K to A and then back to B. Often congestion may thus be caused at A or B and the wagon user is very considerably lengthened. It will be seen that extra haulage costs may offset decreased terminal charges, unless, of course, the traffic is hauled in trainloads.

FIG. 13.

In nearly all foreign countries the practice is to charge a rate from the private siding equal to the rate from the next station. Thus for a wagon despatched by Z in the direction of B the rate would be calculated from A. If the wagon was despatched in the direction of A the rate would be calculated from B. With the almost complete use of railway-owned wagons abroad, the exceptions being only tank cars, refrigerator cars, and other wagons which are very expensive to construct, it is easy by high demurrage rates to control the private siding owner more rigorously. Before leaving the question of private sidings, attention must be called to the economic side of the

problem, which is too frequently left undiscussed, and it is a point which bears closely on the question of social and national welfare. The social question arises as to whether it be fair to the small business to offer reduced rates to the large business which is sufficiently powerful to build and own a private siding, and yet does not send traffic away in trainloads, which viewed from the cost side would be the only reason for offering a reduced rate. The United States has in the main answered this question in the negative, and on the Continent the private siding owner pays higher rates in return for his added privileges. The British railways make no charge for the return empty haul of privately owned wagons, it being assumed that this element is included in the loaded wagon conveyance rate.

Like the question of private sidings, demurrage in this country is a problem which merits urgent attention. Few decisions of the Railway Rates Tribunal have been more important than that given during the summer of 1925, and which came into force on September 1st with regard to demurrage charges on British railways. To ensure efficient and economical freight train working, wagons must be off-loaded and loaded after placing as rapidly as possible. The British trader is especially difficult to deal with in this respect, since he has been accustomed to look upon the railway wagon as his warehouse and in certain events disputes the rights of a railway to charge demurrage at all. Up to this date the post-war demurrage charges were 3*s*. per day per wagon for the first two days after the free period [1] and 5*s*. for all further days ; and 6*d*. per day per sheet and after two days 1*s*., which is 100 per cent. in excess of the 1913 charges. In view of the fact that other charges and the general increase of wholesale prices was 56 per cent. above 1913 levels, the Railway Rates Tribunal lowered the demurrage rates on railway-owned wagons to a straight 3*s*. per day. This decision showed that the Rates Tribunal did not realize the supreme importance of this question in relation to efficient railway operation.

[1] The free period in Great Britain is two days after excluding day of receipt of advice giving notice of arrival.

The result of this lamentable decision is patent to-day when wagons are being held under load all over the country, thus increasing the turn-round of wagons which is technically known as the wagon user. From the social point of view this is highly undesirable; there is no justification for a high level of railway rates, caused by traders using railway wagons as warehouses. Similarly, the siding rent of 1*s.* 6*d.* per day for private wagons is far too small. It is difficult to see how British railways can be expected to operate efficiently and economically when a premium is granted to the trader who causes inefficient working. Foreign railway legislations have no such scruples and the free loading and unloading period is shorter and the charges are very much higher. In Canada the free time is twenty-four hours after notice of arrival, exclusive of Sundays and holidays, based on the first 7 a.m. after placing; after this free time, 1 dollar is charged for the first day, 1 dollar for the second day, and 5 dollars for every day thereafter.

The United States allows forty-eight hours free time after placing, including notice of arrival, with an extra twenty-four hours free for reconsignment or transhipment; demurrage charges at the end of the free time are 2 dollars for each of the first four days, and 5 dollars for every subsequent day. In South Africa only twelve hours grace are given, working hours being from six in the morning to six in the evening except on Saturdays, after which time any wagon up to 16 tons capacity pays 9*s.* per day, other four-wheeled wagons pay 12*s.*, bogie wagons 18*s.*, and sheets 1*s.* 6*d.* per day. The charges in Belgium, after a free period of eight hours if the trader loads and off-loads, and twelve hours where the railway performs these duties, are 50 centimes an hour for the first day, 1 franc an hour for the second day, 1½ francs an hour from the third to the sixth day, and 2½ francs for all succeeding days, every hour in the twenty-four being counted except on Sundays and holidays. In France the trader is allowed the day following the receipt of the arrival notice which reaches him at six in the evening, though in many places the free period is only six hours,

which time applies especially to coal loading ; in practice there is generally a twenty-four hour free period, after which the rates vary according to the time of year. From September 16th to December 15th 15 francs are charged for the first day, 18 for the second day, 20 for the third, and 25 for all other days ; from December 16th to September 15th the charge is 12 francs for the first day, 15 for the second, 15 for the third, and 18 for all other days. Exception is made for traders receiving more than 200 tons in any one day. The demurrage rates for France have recently been raised and must be multiplied by the co-efficient of increase, at present about 4·5, as applied to all freight rates. Twenty-four hours free time is allowed in Germany, then demurrage is charged at the rate of 2 marks for the first twenty-four hours, 4 marks for the second twenty-four hours, and 6 marks for each succeeding twenty-four hours. Privately owned wagons on private sidings are charged 1 mark, and a flat rate of 5 marks is charged for the return of a privately owned wagon running empty. The free time in Austria is normally twenty-four hours, but in time of wagon shortage or for any other cause this is often reduced to six hours.

Under the Railways Act of 1921 the Railway Rates Tribunal must so adjust rates that so far as is possible the railways be permitted to earn the standard revenue allotted to each.[1] Whilst the level of rates to-day nominally stands at an even 60 per cent. above those in force in 1913 there are multitudinous cases where the individual rates have not risen to the same extent ; on the other hand there are probably many individual rates which, mainly through alterations in the classification of freight, stand somewhat above this figure. The only advantage of flat percentage increases lies in their comparative simplicity of application, and it will be realized at once that such flat increases create an unevenness of incidence upon different commodities which is highly undesirable. Table IX, prepared by the Railway Clearing

[1] G.W.R. = £31,965,893 ; L.M.S.R. = £79,457,643 ; L.N.E.R. = £61,038,766 ; S.R. = £23,170,681.

House, shows the history of the flat percentage increases and their gradual reduction upon coal, coke, and patent fuel, and the Classes 1 to 5, which existed up to the end of 1927. The level of rates at the end of 1927 has been in general preserved and is in operation to-day after the coming into force of the "Appointed Day."

TABLE IX

		Jan. 1st, 1920.	Sept. 1st, 1920.	Nov. 1st, 1921.	Jan. 1st, 1922.	May 22nd, 1922.	Aug. 1st, 1922.	Dec. 1st, 1922.	May 1st, 1923.	Aug. 7th, 1923.	Feb. 1st, 1927.
Coal, Coke, and Patent Fuel	Per cent. increase	25	100	100	75	75	60	60	60	50	60
	Flat addition .	3*d.*	6*d.*	6*d.*	4*d.*	3*d.*	2*d.*	2*d.*	2*d.*	2*d.*	2*d.*
	Maximum addition	2/–	4/–	4/–	4/–	3/6	3/6	3/6	3/6	3/6	4/–
Class 1 to 5	Per cent. increase	60	100	100	100	100	75	75	60	50	60
	Flat addition .	1/–	1/–	1/–	1/–	1/–	6*d.*	6*d.*	6*d.*	6*d.*	6*d.*

Agricultural manure received special considerations from the first and its level of increase still stands at 50, instead of 60 per cent., whilst at various times iron ore, limestone, iron and steel, and agricultural products and requisites have all enjoyed comparative advantages. Two outstanding points should be noted, the first being the lack of any increase until 1920, at which time the level of wages and the cost of materials were far higher than in 1913, and secondly the fact that the level of rates to-day approximates closely to the level of retail prices, whilst wholesale prices are considerably lower, the spread in certain cases amounting to as much as twenty points. Whatever views may be held concerning the level of railway wages, there can be no denial of the fact that these are primarily responsible for a high level of railway rates and fares. It is remarkable that with the level of wages at a base of 100 per cent. above the 1913 scale, the railways have found it possible to reduce the level of rates to an increase of only 60 per cent., which compares closely with the general level of the cost of living at present. Consequently railwaymen as a whole have benefited greatly, although in certain grades such a fall in the cost of living is reflected later by decreases in wage

rates according to a sliding scale until an agreed minimum is reached.

As one who considers that America's post war prosperity has been largely due to a high level of wages,—although measured in real wages the rates paid in this country are probably not greatly below American standards,—the above explanation must not be interpreted as a statement that railway wage scales are at present on too high a level. The point should be stressed, however, that it is impossible to stabilize at a high level the most important item of the expenditure side and still expect the level of charges which bring in the revenue to fall in proportion to a decrease in the indices of wholesale and retail prices. With curious lack of foresight the provisions of the Railways Act, 1921, appear to make no allowance for the increasing development of road transport and the sections dealing with charges and with ensuring to the railways a standard revenue take no heed of the economic law of competition. If any supply price is fixed so high that the demand price will never reach it, then there can be no sale for the product, in this case railway service.[1] The apparently simple expedient of raising rates and fares may easily tend to reduce rather than increase gross revenue. The task of the Railway Rates Tribunal is to find the point at which under competitive conditions the standard net revenue can be obtained; from present indications it would appear that such a standard revenue must approximate closely to the maximum net revenue.

The element of danger is present in the fact that only certain traffics, notably those for passenger transport and for light goods requiring short hauls, are suitable for transfer to the alternative system of road transport. Hence the tendency must be to increase the rates on those commodities for the transport of which the railways still hold monopolistic powers. If such a policy prevailed the basic industries of the country, such as coal and the so-called heavy industries, would be charged out of

[1] This may be demonstrated graphically by two curves, one showing the supply prices and the other the demand prices for varying amounts.

existence with consequent ruin to the national well-being. Hence the task of the Railway Rates Tribunal is not an enviable one, since it consists in steering a careful course between the Scylla of a high level of railway rates and the Charybdis of undue advantages offered to certain classes of commodities whose producers are both vocal and possess strong political backing. No better example of this latter danger could be exemplified than the passing of the Hoch-Smith resolution through Congress [1] at Washington, apparently without any opposition from the railway interests. This resolution directed the Interstate Commerce Commission with due regard " to the maintenance of an adequate system of transportation " to investigate and " effect with the least practicable delay such lawful changes in the rate structure of the country as will permit the freedom of movement by common carriers of the products of agriculture . . . including live stock, at the lowest possible rates compatible with the maintenance of adequate transportation service."

In a recent decision,[2] a majority of the Commission declared that " the resolution is, in effect, a direction to us to give agricultural commodities affected by depression the lowest rates that it is possible to give without running counter to the provisions of the Interstate Commerce Act and the carriers' rights under the Constitution."

The American railways as a result of an 8 per cent. reduction ordered on perishable fruit rates from California have finally decided to fight for the repeal or alteration of this resolution. It will be of interest to watch the outcome of this fight, for few instructions to those responsible for the rate-fixing policy of large industrial countries could have been more vicious in their possible effects or more closely allied to politics in their intent. The Interstate Commerce Commission has a justly deserved fame over a long period of years for non-political judgments, and it is unfair to the reputation of

[1] This resolution was passed by the House of Representatives, June 7th, 1924, and by the Senate, January 27th, 1925.

[2] California Fruit Rate Case, 1927.

this far-famed body that they should be instructed to carry out a policy purely political in its bias and origin. After all the Interstate Commerce Commission is definitely instructed by the Transportation Act of 1920 to see that the railways by groups or *in toto* have a level of rates sufficient to permit them, under efficient and economical management, to earn an adequate revenue. It is a difficult problem to make the Hoch-Smith resolution coincide with such an expression of the spirit and letter of the American law. The position has been well expressed by Mr. Storey, President of the Atchison, Topeka and Santa Fé Railway: "That principle is that railroad rates should be cut in order to enable shippers in any temporarily distressed industry to better themselves. There is no feasible way for the carriers to get compensation for the revenue thus lost, since in such cases you cannot pick out another industry and raise rates on it without eventually disrupting all business. One Commissioner, while assenting to the decision, said it was the duty of the Interstate Commerce Commission to balance the reduction by raising rates on something else, but the rest of the Commission said it was up to the railroads to find some such commodity and make application for the necessary increase in rates on it. Such a procedure will never work."

One naturally expects in these days of widespread competition a tremendous pressure by industries to reduce rates whilst the influence of industries against rates increases operates doubly, for a strong and prosperous railway may tend to side with the trader since it is not in vital need of revenue, thus preserving the good will of the trader and expecting thereby an increase in volume of traffic. The railway in sore straits is in a very serious position if any further traffic is lost to it, and, consequently, is forced to consent to the reduction or to oppose any increase in order to avoid losing revenue. There is, however, a limit to the lower level of rates, for if a railway fails to earn a net revenue adequate enough to induce a supply of new capital its physical property cannot be extended and the facilities it can offer will not

expand sufficiently to uphold the prosperity of the area it serves.

The problem facing those responsible for regulation of railway rates is no light one, for their decisions must be based upon many considerations. The extent to which traffic will expand, the purchasing power of currency, the public demand for capital expenditure in the form of electrification, level crossing elimination, and luxurious rolling stock and stations, must all play a part in the formulation of their estimates in addition to a forecast of the future supply price of money.

The incidence of a higher or lower level of rates upon the final price of a commodity is somewhat akin to the study of taxation. In the long run the tendency must be for the producer to take into consideration the cost of movement and local taxation in the form of rates as regards the selling price of his product, but over a short period it may well be that changes in rates bear little relationship to the selling price. Conversely the market price may vary widely without any variation at all in the price charged for transport, namely, railway rates. An absorbing set of studies has been undertaken in this connection during recent years by the Bureau of Railway Economics at Washington, which conclusively prove that seasonal variations have no connection whatever with rail freight rates. A further investigation undertaken by the Georgia Public Service Commission into the freight rates on gasoline on the assumption that "freight rates constitute one of the principal items figured in arriving at the retail price of gasoline delivered to the consumer" proved that such an assumption was incorrect. In its report the Commission said :—

"It is a matter of common knowledge, and is generally understood, that the price of gasoline throughout the north and south is based on the price in Oklahoma plus the freight rate from Oklahoma to the point of destination, but the investigation made by this Commission indicates clearly that such is not the case. In fact, in many instances it does not appear that the freight rate has any controlling part in the price of gasoline."

Recent studies made by the British railways show that the freight rates charged are such a small fraction of the total that any small increases or decreases can have no important effect upon the market price, which is mainly dependent upon the action and reaction of demand and supply. The price of many commodities varies greatly with seasons, as for instance the price of coal in London. With a rate of £14 per 3-ton load of herrings by passenger train from Peterhead to London it is clear that the price per herring will not vary greatly if the rate rises or falls by 10 or even 20 per cent., since such a rate is equal to under ·65 pence per pound. Incidentally this example is a good illustration of the blanket rate principle because the rate in this case is the same from Peterhead to either London, Birmingham, or Liverpool. A case recently reported where three herrings could be bought for one penny at Yarmouth but cost eleven pence at Maidenhead is obviously not explained by railway rates, for in this case over 2 lb. of fish are carried for a penny.

The price of eggs varies enormously according to the season although the rail rate remains constant; in the case of that applying from Truro to London it amounts to only about a penny per half-dozen eggs, although carried by passenger train at express speed; if carried by freight train from Aylesbury to Birmingham the rate per ton works out at only about ·50 pence per dozen, but in smaller quantities of, let us say, 1 cwt. the price rises to ·70 pence. Here one has an example of the economy of bulk consignments, and the cause of the low rates granted for much of the country's import trade.

In short it is clear that small changes in the level of freight rates give cause for little change in retail prices, being entirely outweighed by seasonal changes in the case of many commodities. A comparison of the changes in freight rate levels and the cost of living fluctuations will bear out this statement. Whatever may be the nominal level of rates, the tendency will naturally show itself towards individual but steady reductions. Competition for markets, between railways, or with the road haulier must inevitably create such a position. Each

item of expenditure is considered in detail by the chief executive officer of a railway, even if not by the directors themselves ; the same officer, and certainly the Board of Directors, have practically no voice in the quotation of exceptional rates, hence the revenue tends to fall without check or hindrance, few reductions resulting in a larger gross revenue than existed before the alteration. The rates officer is responsible mainly for revenue ; he knows little and often cares less about the costs of handling the extra traffic he so willingly induces to pass by his lower rate. The American railways have suffered in recent years severely in this respect ; though the level of rates compared to 1914 has suffered no important changes since 1922, the revenue per ton mile has steadily fallen, namely from 1·116 cents in 1923 to about 1·07 in 1927. Changes in types of traffic would have tended rather to offset this decrease than to accentuate it.

The universal demand upon all bodies responsible for the regulation of railway rates for assistance to the depressed industries in the form of lower rate scales, which in fact is a form of subsidy by other industries, is a development worthy of the closest study. Such demands rest presumably upon the unprofitable results of trading during the previous years. It is certainly not the function of a Rates Tribunal or Public Service Commission to investigate the efficiency or economical management of the industry in question. If trade union rates of pay cause one coalfield to work at a loss whilst a lower scale is paid to non-union labour at mines in another coalfield, it is not the duty of a Rates Tribunal to offset such differences by a variation in rate scales for the two coalfields. On the other hand the former coalfield may certainly look upon itself as a depressed industry, but if its rates are reduced it may be impossible to prevent the competitive railway serving the other coalfield from reducing its rates in order to retain a market. The consumers in that market will most certainly oppose any efforts to prohibit such a reduction in rates. This position appears to have actually arisen in an acute form in the United States, and the method

of circumventing it should be followed with keen interest by those responsible for rates policies in other countries. Whether rates are to be designed to yield a standard revenue as in Great Britain or a fair rate of return on capital as in the United States, it becomes essential to find products which can bear a higher railway rate coincident with the yield of a greater net revenue if rates upon the raw materials or products of depressed industries are to be relieved partially of their burden. It remains, however, a problem as to what the definition of a depressed industry is.

Prior to closing this brief discourse on the problem of rate making, one may with advantage summarize the main principles of freight rate scale construction. As compared with passenger fares freight rates are more competitive and a low scale for the latter will automatically induce the growth of industry from which passenger revenue will inevitably follow. The classification of freight is more complicated and the terminal expenses connected with its handling are much heavier. As a factor in railway freight rates cost is most important since in the long run no rate should be so low as not to cover prime costs, though taken as a whole costs are those of a joint nature to be covered by revenue from passenger and freight trains. Unavoidably some traffic will assuredly tend to subsidize other traffic. In any collection and delivery rate the elements of cost include those of collection, loading, sheeting, use of terminal, haulage, use of wagon, use of terminal, unsheeting, unloading, delivery, and overhead management costs. Use of certain services only may not reduce the actual cost to the railway at all whilst the bulk of consignment, volume of traffic, and speed of movement, must change appreciably the per unit cost.

In fixing the upper limit to the rate scale the ideal to be aimed at is the maximum net revenue, in other words, the volume of traffic to be desired is that which will yield the greatest margin between the cost of movement and the gross revenue obtained. Rates may be charged upon a flat-scale system, as was for some years employed

in Great Britain, or on the zone system, such as the postal system taking Great Britain as one zone. The more normal system by rail is, however, an equal mileage system which tapers off to a lower rate per ton for longer mileage to induce long distance traffic. In certain countries one finds a so-called fabrication in transit rate granting a through rate but permitting a process to be applied to the goods at some place *en route*. The United States gives us many examples of the basing point system, by which low rates are based on a competitive route from A to B, centres round B being charged at the normal rate from B, which is added to the rate A B, though the goods may never in practice touch B.

Lastly, one finds the blanket rate, covering wide areas served from a single very distant point of departure. More than once, the Interstate Commerce Commission has commented favourably on the employment of gross ton mile earnings as a system of testing the reasonableness of a rate structure. Unfortunately in Great Britain the gross ton mile figure is not available, but with a comparison available between the work done and the revenue per net ton mile derived from that work, an accurate study can be obtained. In his *Anatomy of a Railroad Report*, Mr. Woodlock, himself now a member of the Commission, mentions this method. However important other considerations may be distance will apparently remain the basis of both passenger and freight rate scales. The former have not yet as a whole been adapted to the tapering rate scale, the latter almost invariably have been. The rate structure of Great Britain is honeycombed with exceptional rates, necessarily resulting from world-wide trade and water competition; the main function of the Rates Tribunal will remain, as with all similar bodies, that of finding the comparative scales to be applied to the products of the different industries, and the careful balancing of the demands of producing centres for comparative advantages over their competitors.

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CHAPTER VIII

THE ECONOMICS OF PASSENGER-TRAIN OPERATION

The first point which may be dealt with to advantage when one enters upon a study of passenger train service and problems in this country is the proportion of expenditure and revenue derived by the railways from this branch of the services offered. As regards the problem of apportioning the expenditure between the freight and passenger services, it is the general opinion in Great Britain that the cost involved, if it were reasonably possible, would absolutely outweigh any likely advantages to be gained. As a matter of fact, it will be realized that accuracy can never be attained in this matter, as the measurement of wear and tear caused by passenger and freight trains to rails is quite impossible to gauge.

A few examples should suffice to make this quite clear. Taking the simplest first: a small four-coupled tank engine is employed on the branch from Exeville to Eyeville; it works about eight round trips daily on passenger service and possibly one or two on freight service. How can one divide the expenditure incurred in running expenses, such as coal, water, enginemen's wages, and wear and tear on rails, sleepers, and track in general? It would be out of all proportion to the advantages to be obtained if the station-master at Eyeville was required to fill up a form each day stating how many hours and minutes had been respectively assigned to his superintendence of freight and passenger traffic matters. On certain branch lines of very light traffic, trains consist of passenger and freight vehicles which would make the division of freight and passenger costs very intricate.

Unlike our Ministry of Transport, the American Inter-

state Commerce Commission requires expenditure to be divided into the two headings of freight train expenditure and passenger train expenditure, but this is not carried usually as far as the department of maintenance for permanent way and structures. Figures have from time to time been published which show the position as far as it can be shown, but they cannot be regarded as accurate, and the assumptions required to enable such figures to be produced materially undermine their value when completed.

With regard to revenue it is altogether another matter, and the following figures (Table X) show the percentage of revenue derived from passenger train traffic and freight train traffic on the four British railways during a recent year.

TABLE X

	Passenger Train Traffic. Per cent.	Freight Train Traffic. Per cent.
L.N.E.R.	39	61
L.M.S.R.	42	58
G.W.R.	45	55
S.R.	74	26

The economic problem is one of joint costs, and in that sense is one of the most difficult that any industry has to face. Just as the Gas Company produces coke as a by-product in addition to the gas, and the packers of America produce skins, hoofs and other products as well as meat, so the railways produce passenger train service as well as freight train service. It will be seen that this characteristic of railway operation greatly increases the difficulties of regulation. The question of the charges made for the various services has been discussed in a previous chapter, and it is now time to discuss the economic problems which arise from the operation of passenger trains.

What are the leading differences between passenger and freight train operation? In the case of passenger train operation a railway must offer a regular service. As a whole it cannot be radically changed, although summer train demands materially affect a

service, and market days, in a smaller degree, cause additional services on certain days in the week, but to a great extent it is not radically altered by seasonal changes at any rate in Great Britain where the climate is temperate. Passenger movement requires as high a standard of speed as possible. There is no great difference between the desire of Mrs. Jones with her market basket to reach home, and of Mr. Smith to return home after his day at the office. Punctuality is essential from the public's and the railway's points of view. With comparatively few exceptions passenger train traffic balances in the two directions. The passenger who goes in one direction is on the average much the same shape, size, and weight as the passenger who goes in the other direction. Totally different is much of the freight traffic which moves in this country. Thus wagons carrying coal for export at Garston cannot return loaded with bananas imported from Santa Marta, for the latter require a specially warmed van. The passenger from Edinburgh, however, can be accommodated in the same carriage which has been used for the passenger to Edinburgh.

Passengers do not require to be unloaded, though they do require expensive loading and unloading structures, but in this respect it must not be forgotten that milk, parcels, and perishable traffic is often handled on passenger trains. There are less accounting costs in the case of passenger traffic, as classes are more limited; almost regardless of cost, a high standard of safety must be ensured for passenger traffic. There is no case of charging the passenger as much as he will bear, as normally he has a choice of classes, a characteristic which is not true of freight traffic, although there is often a choice between carriage at the Railway Company's risk or at owners' risk. The passenger must be looked after *en route*, comparing in this respect somewhat with livestock, but not with ordinary freight, which, once it is loaded is not touched until it reaches a transfer station or its final destination station. Considerations of comfort are paramount if traffic is to be retained in these days of road competition.

These characteristics should be remembered during our study of the problems of passenger train operation. Probably the best point at which to start this study is at the terminal point, namely the passenger station. Here, there are two main problems : the station design itself, and the lay-out of the track in the station. The latter is, if anything, the more important, but naturally, one is complementary to the other. For our purposes it will be preferable to divide our study into two groups. The first is the big stub-end, or dead-end, passenger terminal, such as Liverpool Street Station, London and North Eastern Railway, or on a smaller scale Princes Street Station, Edinburgh, London, Midland and Scottish Railway. Great Britain has probably a larger percentage of such stations than any other country, in view of its long shore line, with many branches stretching out towards the coast having terminal stations at their extremities.

The second is the main line station with through roads and possibly bays, such as New Street, Birmingham (L.M.S.R.), and Snow Hill, Birmingham (G.W.R.). Amongst the largest of such stations in Great Britain are Crewe (L.M.S.R.), Waverley, Edinburgh (L.N.E.R.), Clapham Junction (S.R.), and Reading (G.W.R.). Some of these have exceptionally long platforms capable of taking two trains at the same time ; thus, Manchester, Victoria and Exchange, has a platform of 2,175 feet ; York, one of 1,692 feet ; Waverley has one of 1,680 feet ; and Crewe, one of 1,509 feet. Cambridge is one of the most famous stations of this type, but it is quite unique in this country for its design, and although resignalled recently with the latest double direction system, is not an example of station lay-out to be emulated ; it is typical of the situation in Great Britain where opportunities for ideal stations are very rare, owing to lack of space and heavy cost of adjoining land. Even opportunities for rebuilding stations will become rarer if the health of railway credit does not improve in the near future. Stress may therefore rather be placed on the methods of bringing old stations up to date than explanation of the ideal features of totally new structures.

Dealing first with the roadside station, it will be realized that it may be designed with two single-faced platforms or with an island platform. The latter is on the whole the cheaper to operate, but it may involve reductions of speed, and its first construction is not often as cheap, for subways or bridges must be built to enable ingress and egress. A difficulty is often met with in this design as to where to place the goods yard. Normally with this island type the yard is either on the up or down side, as in the case of a two single-sided platform station, but if that is done one of the main advantages of the island-type station is lost, namely the prevention of crossings on the main running lines. The island type is especially useful in the case of branch-line junction stations where trains have to travel over the main line to enter the station, but even here there are problems created by the normal necessity of the branch-train locomotive having to run round its train, or having to perform useful shunting work in between its branch-line trips. Each through station should have an adequate freight shed, siding accommodation, the necessary cross-overs, live-stock loading and unloading facilities, all sufficiently well lighted to ensure efficient working after dark. As regards cranage it is considered better by many to have this mounted on wagons rather than fitted permanently in any one position.

The passenger side should conform where possible to the Ministry of Transport regulations, in any case new or rebuilt stations must conform to these standards, which require a minimum platform height of 3 feet with overlap of 1 foot, a minimum width of 12 feet, with no fixed standard nearer than 6 feet, and certain regulations for the number, width of tread and depth of bridge stairs, and ramps not steeper than one in eight. Any crossing of the line should be strictly prohibited, whether by the staff or passengers, and where possible ramps as at Ely Station, L.N.E.R., are much better than stairs, though the former must not be too steep, and for the sake of saving space luggage lifts may be regarded as preferable. Clocks, station-name boards, and train

services should be clearly displayed, waiting-rooms kept clean, also lamps, while seating accommodation should be adequate for normal needs. Advertisements should be carefully displayed and where possible flowers and bushes should be planted to make the station attractive. British railways have much to learn from American lines regarding the lighting of station names at night, though the feature of time-tables lighted from the inside by electricity, such as has long been the practice on the L.N.E.R. and the S.R., is one which many foreign railways might copy with advantage.

It is normally impossible to avoid shunting operations which necessitate crossing the other main running road, except where it can be arranged that small stations be served with pick-up freight trains running in one direction only. This latter problem will be discussed more fully later, but it necessitates much added unremunerative haulage, and the service is naturally apt to be slower. In all cases, of course, platforms should be long enough to accommodate eight or twelve bogie carriages, with a minimum of 480 or 760 feet in suburban areas and at important main-line stations, but it is quite impossible to lay down any definite length, each case depending upon local circumstances. What can be laid down, however, is that the platforms should be two carriage-lengths longer than the average train length to facilitate a rapid arrival.

It is often stated that the original construction of station platforms to their present height was an undesirable feature of British railway practice. The main objection lies in the great cost of providing such facilities, and the greater capital expenditure if such platforms have to be lengthened to-day. Such an opinion appears to disregard the many advantages which have accrued from the practice of high platforms, namely the far greater rapidity with which trains can be dealt with, the lowered risk of injury to passengers, and the avoidance of expenditure required to raise a platform when electrification on the third-rail system is adopted. To point to France, Germany, Belgium, or America, as examples is to dis-

regard the comparative density of trains in these countries and in Great Britain. Our own problem is that of a highly dense passenger traffic, with as great a speed as possible, and the minimum of station time: to attain this end the high platform system has given the greatest assistance.

In the case of the terminal station, one may deal first with the design of the station itself, and an island road site is the ideal to aim at. Such an island site yields the maximum of road area in close proximity to the station and tends to prevent street congestion in its neighbourhood, a problem already acute in regard to the two big terminals in New York City, the Grand Central of the New York Central Lines, and the New York, New Haven and Hartford, and the Pennsylvania Station. Reference to the latter naturally leads to the question of architectural beauty, a matter too often totally disregarded by the early railways of this country. King's Cross, St. Pancras, and Euston were all regarded as masterpieces in their day, but opinion varies as to the most desirable type of station architecture. Certain it is that American railways recently, and Continental railways for many years past, have paid far greater attention to this matter than we have, though in the latter case it has often been at the expense of the railway lay-out within the station. Of the two the British extreme is probably the more desirable, though St. Pancras may claim to possess not only an architectural impressiveness but also a good railway lay-out within. Thanks to electric train service the two great terminals of New York City have been enabled to develop air rights from which the terminal Company can obtain an important revenue. One of the most serious problems facing the station designer is to ensure the even loading of trains, and with the dead-end terminus this is extremely difficult, in fact it is doubtful whether any system of bridges or subways at the departure ends of the platform will ever conquer the gregarious habits of the human being who prefers to stand in a herd in the last carriage of a train rather than rest in the comfort of a corner seat in the first carriage.

The main feature of design should be to interrupt as little as possible the direct flow of passengers from the road entrance to the platforms past the booking offices, inquiry office, and train indicator in as direct a line as possible. Any system tending to divide the peak-hour streams automatically into east and west side suburban and main line traffic as at Liverpool Street, which deals with nearly a quarter of a million passengers on a week-day, by steam trains only, is desirable, whilst regular departures at so many minutes past the hour are advisable where possible.

Regarding the problems raised by parcels traffic, this should be kept as separate as possible from passenger traffic, and carried in underground passages which feed the platforms by lifts, the parcels themselves arriving at a separate entrance. Leipzig Station may be quoted as a good example of this, although the German and American system of providing each platform with an auxiliary platform for luggage and parcels traffic only is one which, however ideal, can never be attained in this country owing to considerations of space. Additionally it is very doubtful if, under British conditions of so much hand luggage, it would prove a paying proposition. On the staff side are the problems relative to the adequate design of lamp rooms, first-aid and mess rooms, while the passengers naturally require good restaurant accommodation and waiting-rooms.

The problem of track lay-out must vary with individual cases, but in connection therewith may be mentioned the desirability of the S design of barrier which saves considerable space and tends to separate a crowd, while the removal of smoke has received comparatively little attention from station designers. In the United States the big span roof, so notable at Boston South Station, and of which the most famous British case is probably St. Pancras, has long given way, owing to high maintenance costs, to the low butterfly type over each platform, permitting the smoke to be carried away at once, while the additional freight platform permits a narrow passenger platform, and sheet glass placed over

the platform barriers greatly decreases the draught in cold weather. Good telephone and bell communication is essential for adequate control of a large station and the use of the teletype machine in announcing arrival platforms and for other uses is only in its infancy.

It may be that our stations have been built on too permanent a scale in the past, and that more rebuilding might have been undertaken if the depreciation could have been covered in a shorter period, but against this one must balance the advantage of a strong structure for which maintenance charges have been comparatively light.

The track facilities of a big station are probably its most important feature. The incessant call for extra line capacity does not always bring with it the relief expected, since added tracks involve in most cases added crossings which increase interlocking difficulties, and tend to bring trains to a standstill waiting for a clear road at exactly those places which are carrying the greatest density of traffic. To choose between giving a clear run in and a clear run out of a large terminal is by no means easy ; in the first case an attempt is made to ensure a punctual arrival, and in the second to ensure that the train does not, by a run late throughout, upset connecting or following trains, although there is the probability that it will be enabled to make up the all-important minute or two. On the whole the second is probably the lesser evil, since it tends to free the station of congestion.

The position of locomotive facilities, such as water cranes, coal bunkers, and turntables, is one of the highest importance, since engine movements at the hours of heaviest traffic should be kept to the lowest limit possible. It is curious that the lay-out of so few railway passenger termini has been planned to permit storage tracks for empty carriage trains between the up and down lines, such as exist at Paddington, where no less than fifty-two trains can be garaged during the slack period of the day. Waterloo garages the carriages of its electric set trains, which are only employed at peak periods, but few stations have enough available space to adopt this system. Even

the long 1,500-foot platform at Victoria (Central Section), Southern Railway, is not suited for this method. The economic waste resulting from the haulage of empty trains to the various carriage sidings is an unfortunate feature of London's passenger station lay-outs, but only heavy capital expenditure could now obviate the wasteful system. At the Grand Central Station in New York City, where adequate garage space for about thirty electric units is available in the suburban station level, the empty main line trains have to be hauled several miles to and from the carriage sidings.

The adoption of electric fouling bars, track circuits, colour light signals, and lighted diagrams have all tended to ease the operating problem at large termini, and to increase the train capacity; but increasing population and the consequent demand for passenger travel have more than kept pace with these improvements, and the race between the demand for new facilities and their supply is as strong as ever.

The suburban passenger problem is discussed further in the chapter dealing with electrification, in itself closely connected with terminal station design; but before turning attention to passenger train operation between terminals, one may stress the importance of reducing turn round time and time at intermediate stations to the minimum. Two British trunk railways have concentrated on this problem and on one the suburban station time has been reduced to a nominal twenty seconds, though in many cases in practice it only amounts to twelve seconds, whilst certain of its main line trains turn round in London in well under twelve minutes. Such a policy increases the passenger-train carriage-user figure to an important degree, but if, owing to failures, a carriage has to be cut out from a train, the delay so caused is fatal to punctuality records; also the customary cleaning of trains is necessarily perfunctory under such conditions.

There is, perhaps, no more important feature of railway operation than that of time-table design. The reason for this is fourfold. Firstly, it affects the travelling public intimately, and hence affects revenue. Secondly, it may

cause increased expenditure by inefficient use of rolling stock. Thirdly, badly arranged time-tables cause interminable delays, increase locomotive and running costs, and increase overtime, which is undesirable from whatever point of view it is judged. Lastly, if badly organized, it has disastrous effects on the morale of the staff. It would be useless to discuss the problem of arranging an entirely new time-table, because our problem is invariably the one of improving existing tables. The main objectives to be attained are the reduction of cost, and the better or more even loading of trains. As regards the latter it may be a matter of surprise that suburban trains do not load evenly throughout crush hours. But there exist in practice what might be termed sub-peaks for trains arriving at 8.25, 8.45, 9.25, at Liverpool Street, for example. This is, of course, due to the opening of offices at 9 o'clock, 9.30 a.m. and so forth. Generally speaking the peak period is shorter and consequently more acute in the evening than in the morning. The suburban traffic problem is, however, of a very specialized nature and may be suitably dealt with when the problem of electrification is discussed, since in many cases electrification would serve at least to ameliorate the crush conditions at present existing.

Before studying the construction of a working time-table, it is worth while to recall the fact that an adequate or inadequate service may make or mar a locality. Compare the suburbs near London ; the rate of building bears a close relationship to the quality of the train service. The GreatWestern, partly from the position of Paddington, which is far removed from City offices, has never developed a great suburban service. Euston until recent years was never greatly interested in suburban dwellers ; the London, Brighton and South Coast Railway, and the London and South Western, on the south of London, and the Great Northern and the Great Eastern Railways, on the north, however, built up an enormous season and workmen's ticket traffic, although in the case of the last named it was not entirely a question of choice.

An example of the effect of train services and the

location of running sheds upon the growth of two suburbs is shown in Fig. 14. Let us suppose B and C are two small branch termini, about 20 miles from London, reached through A. C possesses a small shed for two or three locomotives, and B does not. The Railway Company, because that shed is at C, will offer a much later service to C than to B, as the locomotive of this last train to B must return through A to C. Residents at B will, therefore, have difficulty in reaching home from a London theatre, or other amusement, and will not obtain the same early morning train service as C, consequently there will be a natural tendency for C to grow faster than B,

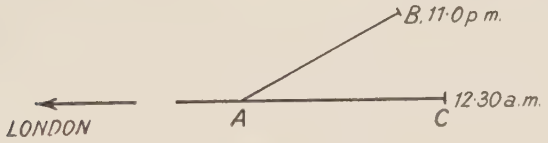

Fig. 14.

entirely due to the location of an engine shed at C. A similar kind of example may be taken to demonstrate the greater popularity of one market town than another, owing to the more convenient time of the local train conveying livestock.

The train service is worked out many weeks ahead of the time it is to be put into operation, and is known as a working time-table, which varies in some respects from the form in which it is presented to the public; thus the passing times of trains are shown at stations where they do not stop, and freight train movements as well as those of light engines and empty carriage trains are also included.

There are two systems of preparing a working time-table.

(1) The train diagram method.

(2) The older figure method.

Most railways now use the former method which has many advantages if well done. The following rough diagram (Fig. 15) will show the general method applied to six trains.

The position of the stations here shown assumes that they are equidistant. A diagram should show the gradients along the left-hand side. A method of using coloured wools, which are pinned upon the diagram, may be of service. Points to be noticed are :—

1. Down trains from Appleden to Higherden will slope downwards to the right.

2. Up trains from Higherden to Appleden will slope upwards to the right.

3. The greater the speed the steeper the line.

4. Various colours for different types of trains.

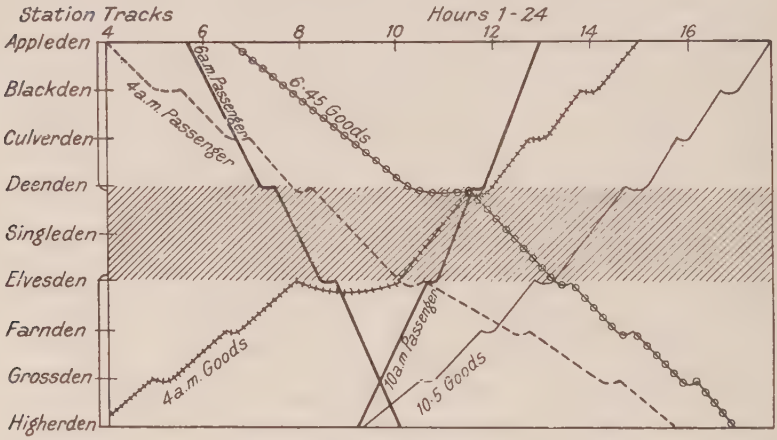

Fig. 15.

5. Single line sections shaded.

6. Effect of gradients. 7. Horizontal line for stops.

8. No lines should cross on single lines except at loops, shown on left margin.

9. It is preferable to have separate sheets for up and down traffic and for main and local lines, where traffic is dense.

There are certain cases where the diagram system is not desirable, as, for instance, in the London districts of the Southern, where the crossings and junctions are so frequent and intricate that the clearances are necessarily measured by seconds rather than minutes, and judgment must perforce be left in the hands of the signalman on

the spot. With the ordinary steam service diagramming of trains with such narrow margins is not worthy of the time and labour required ; in cases where it is attempted the diagramming work should be on a large scale so as to be amply clear. It should not be gathered from this that such accurate schedules with passes measured in seconds are not highly desirable in such cases as the Underground, but this is a special case, where speeds are even, trains normally of even tare weight, station stops of even length, and gradients designed especially for the traffic ; in addition automatic train control is in use.

The working time-table is usually arranged by a trains office. In certain cases the tables are all designed by a trains office at the Operating Headquarters, in other cases the tables are made up in the Divisional or District trains offices under the supervision of the Divisional Operating Superintendent. When a big alteration is to take place in a time-table a representative of the headquarters time-table section, and of the District Trains office, as well as representatives of the Passenger Manager's Department, Goods Manager's Department, and Locomotive Running Department arrange a conference and in due course the first proof of the new time-table is circulated and checked by the districts. It used to be the custom to circulate a second proof, but in many cases this is now eliminated as it is costly, and if the first is checked with accuracy should be needless, but it depends on the number of corrections which have to be made. The working time book should for convenience and economy be divided into small sections, and should include all trains, both freight and passenger, in the same set of tables, otherwise the occupancy of the lines cannot be successfully gauged. Passing times at important stations should be shown in addition to booked stops.

As soon as one time-table—for instance, that for July 1st—is produced, a commencement is made in the preparation of the coming winter table. Use may be made of indentation for branches, whilst various methods have been adopted to deal with the differences of A.M. and P.M. times, such as heavy type, but without doubt the

best is the use of the 24-hour clock, which would greatly simplify the British railway time-tables. The American system of reading up and down for the different direction of the trains is not easily applicable to British conditions, as our train service is so dense that a whole page at least is usually given to one direction traffic. Mileage between stations and important signal-boxes should also be shown, whilst the originating station of a train should, where possible, be written against it. Italics are useful as showing trains run on certain days of the week only, and dotted lines to show passing points with unbroken lines to show stations not passed by the train in question. The transfer system of moving a train several columns on after it has been passed by those which left at later times simplifies the reading, whilst the final arrival station of a train whose journey is continued on a further table is a useful adjunct.

Points to remember in designing time-tables, which should be entirely in the hands of the operating department, are :—

1. The effect of gradients.
2. The locomotive power available for the train in question, and in connection therewith the classification of engine power is absolutely essential.
3. The tare weight of passenger trains, and the probable gross weight of freight trains.
4. A reasonable allowance for making up time.
5. Adequate station time should be allowed.
6. Extra time should be allowed for at stations where trains have to draw up twice.
7. Trains must be run at suitable times for the public and not to suit the convenience of the operating department.
8. The series method of train paths—that is, 11.0, 11.10, 11.20 ; 12.0, 12.10, 12.20—is preferable to 11.5, 11.27, 11.40 ; etc.
9. Every train or light engine should have a path and there should be adequate paths left for summer additional trains, or second portions.
10. Running a train in several portions is far less desirable than running two separate trains.

11. Close co-operation with the rolling stock controller is an essential.

12. There should also be close co-operation with the locomotive running staff, whether a separate department or part of the operating department.

With the large percentage of revenue obtained from passenger traffic in this country, the control of passenger train vehicle working is a most important factor in railway operating efficiency. The main objective of the rolling stock controller in designing his carriage and set train roster is to obtain the maximum mileage per twenty-four hours from the rolling stock at his disposal. If an improvement is effected in this direction, it may delay the requirements of new rolling stock, and consequently the rolling stock controller, if efficient, may be regarded as the great enemy of the meticulous passenger. In the design of the passenger carriage roster one comes against a large number of those conflicting considerations which one meets in the study of all economic questions. What is the first ideal ? Theoretically all trains should as far as possible be kept in sets. This is possible for many trains, such as the " Royal Scot," the " Queen of Scots," the " Cornish Riviera Limited," the " Atlantic Coast Express," the " Southern Belle," the " Golden Arrow " of the Nord, Continental trains to Harwich, and suburban trains which, consisting of eight or ten coaches, can be divided into two sets each, for work during the quiet midday period.

Yet such a system, however desirable, must be modified in many respects. Firstly, it is essential to have spare cars for replacement on the main line services, and in practice the ratio of these to the set train must vary with circumstances, but the ratio of 1 to 10 should prove ample unless such trains require strengthening for the whole duration of the summer services. It may be explained that about 7 per cent. of carriages normally await repair. Thus there must be a certain number of spare cars. The second type of modification is necessitated by variations in loading. In such services as that between London and Brighton the variation in loading

between the different trains causes great difficulties. An eight o'clock business train to London is utterly useless for return on a ten-thirty service. The proportion of first-class accommodation for one thing would have to be altered. On the Great Eastern section of the London and North Eastern Railway, the mileage and, consequently, the journey time rather eases this situation as morning trains up can form afternoon trains down successfully. In short the considerations of set trains versus the reduction of empty seats can only be solved for each case separately. It may be cheaper to run whole-set trains than to divide them in half for slack periods ; thus the Southern Railway on certain sections invariably runs full-set trains all day, whilst in Paris the habit of returning home to the suburbs for lunch prevents the reduction of coaches on the suburban trains at the midday period.

As in the case of the working time-table this can be done diagrammatically or numerically. The systems employed differ with each railway, but a typical example of the numerical system might be the following :—

Working 262

			From	To	Time of Arrival.	
	Empty	7.18 a.m.	R sidings	P	7.36	
Set Train 848.	Loaded	8.00 a.m.	P	J	10.14	Reduce train by one bogie composite carriage.
	Loaded	11.10 a.m.	J	W	12.30	Take in water and gas.
	Loaded	3.05 p.m.	W	J	4.20	Add one bogie composite carriage.
	Loaded	5.25 p.m.	J	P	7.50	
	Empty	8.12 p.m.	P	R sidings	8.31	

The tare weight of each set train should be shown as well as the station at which it is to be washed, preferably before commencement of working in the morning. It is not necessary for set 848, for example, to be used on working 262 every week-day, but if this can be arranged economically it tends to simplify the working, which is

highly desirable. The elimination of empty running must be done where possible, but sometimes in this case the position of the carriage sidings makes economical working difficult. Over a large district of one of our railways, about 5 per cent. of coaching train miles is run empty, that is, worked out on the basis of loaded-train mileage and empty-train mileage, and not on the seats occupied basis. Shunting miles in another case are equivalent to 6 per cent. of the total train miles, and 25 per cent. of these shunting miles for coaching stock is carried out by the train engines. On other lines more than 50 per cent. is done by train engines. Although to a large extent this is wasted energy, it is very difficult to reduce it, though every endeavour should be made to that end. The problem of "Through Carriages" is a good example of the inherent difficulties, as the through carriage undoubtedly increases revenue, but naturally creates difficult shunting problems at large transfer stations, such as Crewe, Shrewsbury, Perth, and Carlisle.

Coaching train miles per train hour give a fairly good indication of the efficiency of a carriage roster. This figure for the four Companies varies from month to month, but during a recent August lay between 13·47 for the L.M.S.R. and 14·11 for the Southern Railway. With efficient stock rostering no carriage in train service should do less than 100 miles per day, but it will not be at all easy in many cases to design a roster to achieve this result. Such problems as whether a shuttle service gives a better mileage result than a series of connections of through services, offer a distinct fascination, and the attendant questions they raise are far reaching. A through service will tend to save station time and the occupation of valuable platform road accommodation, on the other hand it may tend to unpunctuality through waiting for connections, the rolling stock may offer too many seats on the second section run over, with consequent waste of tare weight hauled; the proportions of first- to third-class accommodation may be undesirable, and in addition is the difficulty of arranging a service to ensure a return after, perhaps, five days to the original

home station for cleaning, inspection, and other purposes.

Traffic censuses must be taken from time to time for the benefit of rolling stock controllers, who also receive, in most cases, weekly returns of spare coaching stock on hand in each district. The advantages and disadvantages of centralized coaching stock control are continually under discussion; possibly such a system achieves a better carriage user figure, but it also tends to ignore local requirements as to the cleaning of passenger-train rolling stock as well as to starve districts in times of heavy traffic. The overcrowding which can be observed at most large stations during national holidays must in the long run lead to increased loss of passenger traffic to road services.

The following minor points may be mentioned before leaving this problem of the rolling stock control. It is the custom on most railways to issue daily instructions with regard to special movements, as well as to make provision for the working back of spare rolling stock to the home station. This leads to the question as to whether carriage rolling stock should be allotted to definite stations or districts. On the whole the answer would appear to be in the affirmative, as any such system tends to the better maintenance of the carriage sets, and makes the incidence of responsibility clearer. Finally, in busy stations the use of platform occupation lists has been found to be very useful; these enable the staff to work out their own plans in accordance with the proper schedule, and with the dense traffic of British lines to-day no question such as this should be left to chance, if train delays are to be avoided.

Although the methods of designing the locomotive working schedules and trips vary widely on the different railways, and even vary to some extent between the various sections of the same railway, there are, as with the design of the train time-tables, two main systems of design, namely, the diagram system and the numerical system. Naturally the design of the working time-table must come first, but to make certain of the most efficient and economical locomotive running, the working time-table

should be alterable in small details to achieve this end. A locomotive working diagram takes the following plan (Fig. 16) :—

Arrive. a.m.		A *depot.* Depart. a.m.
	On duty	5.50
	Loco'	6.35
	Beetown	6.50
7.39	Ceetown	8.43
9.28	Beetown	10.4
		noon
10.48	Ceetown	12.0
p.m.		p.m.
12.44	Beetown	2.26
3.48	Deetown	6.5
7.35	Beetown	8.39
9.23	Ceetown	10.0
10.42	Beetown	
	Loco'	

Fig. 16.—Numerical Method.

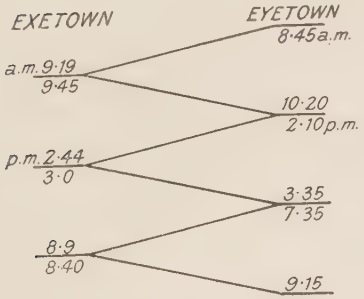

Fig. 17.—Diagram Method.

In making up locomotive diagrams the main object is to avoid the locomotive being held up for long periods in steam awaiting the train departure times. Like time-table working, a locomotive schedule diagram is by no means finished with when the schedule has been duly arranged ; neither of these is ever so perfect that it cannot be improved upon. Continual checking of a passenger train at the same distant signal day after day should be a source of inquiry as to whether the margin

between it and other trains cannot be widened, but care should be taken to avoid continual minor changes which are liable to make the working more difficult for the operating staff. The index to efficient locomotive rostering is, naturally, the train miles per engine hour, and engine miles per engine hour. These should be studied each month by representatives of the locomotive running and operating departments. Any growth in the proportion of shunting mileage and assisting mileage should be traced and corrective measures taken.

The old method of each crew having its own engine seems to have died out for good in this country. The more the pity, as it is doubtful if it is not the most economical in the long run. In France the Nord and Est Railways have gone back to this system and are very pleased with the results. Even in America one crew per locomotive has been reverted to, in certain cases ; but where long non-stop locomotive running is in force this method tends to increase the number of nights spent away by the engine crew, who do not for that reason always favour it, though they invariably appreciate the chance of keeping their own engine. The tendency would seem to be the gradual evolving of double crew working for each express locomotive, while the link system permits the evening of hours worked, and certain lighter work which a locomotive can be put on, prior to shed attention. In any case, the table or diagram showing the engine working for the express links should show the time the crew signs on ; the time they sign off ; transfers from one engine to another, if any ; the hours on duty ; and the train miles worked during the hours of duty. Signing on time varies from twenty to sixty minutes before train departure time, depending on the position of the locomotive shed in relationship to the passenger station terminal. Engine working diagrams should be circulated freely so that yard-masters and station-masters should have an adequate knowledge of the locomotive working, as well as the engine crews themselves.

The practice in regard to trip and pilot engine working varies considerably, but careful schedules should be made

of the trips worked by the various trip engines. For the sake of clarity each trip engine should be given a number, as at Derby (L.M.S.R.) and Waterloo (S.R.), or letters, as at Calais (Nord.) The trips must to a large extent depend on seasonal and general traffic conditions, and cannot be completely scheduled, but overlapping can to a certain extent be eliminated by yard or local control work as at Newcastle. Mineral working at Middlesbrough requires a similar type of working, but this will be dealt with later under freight train operation.

The duties of a station-master may, perhaps, be summed up in two words—throughput and discipline. Before discussing these two separate but closely related points it is worth recalling that the station-master's is the key position on the railway. Firstly, he is, under normal British railway conditions, the highest official responsible to many departments. The district superintendent is on the operating side ; the commercial superintendent is responsible to the passenger and goods managers ; but the station-master is responsible for the working of all three departments, and in a way he is responsible to the engineer's department as well, for the upkeep and maintenance of the signalling equipment, though technically perhaps that is the linesmen's duty. Diagrammatically one gets the following (Fig. 18) :—

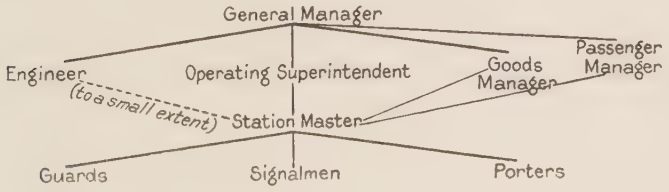

Fig. 18.

Similarly, the station-master is the lowest official responsible for the general working of all departments. From the diagram his importance is clear ; the whole railway in his area is his responsibility for efficiency or inefficiency, consequently his responsibility is great. In France this is more than ever true, and the Chef de Gare

is the all-important person, in fact he is a district superintendent on a small scale. On certain railways his responsibility is lessened with the control system, the advantages and disadvantages of which will be entered into in some detail later, though any system which tends to lessen the initiative of the man on the spot should be able to exhibit very distinct advantages before its adoption is warranted.

The station-master is essentially responsible for throughput ; his main objective should be to pass traffic as rapidly as possible through the area in his immediate charge, with as little expenditure of man power, fuel, and expense as possible. It may be a question of getting wagons off-loaded, reducing demurrage charges for his clients, and releasing wagons for the railway ; it may be reducing the station time of expresses, or the shunting time of goods trains. It may be the problem of increasing the capacity of his line by better station working, in every case it is a question of bettering throughput. To take an example : an extra train is desired for market day at a branch line terminus, the line capacity is sufficient, but there is no platform available to receive the train ; it is essentially a case for the station-master to find the means of increasing his platform availability and thus to increase the throughput of trains.

It is often remarked that one cannot get more than a pint into a pint pot ; the simile, as regards the traffic problem, is useless, since it disregards all question of speed. The transport problem is not that of filling a pint pot and emptying it, it is that of passing as much through a pipe as possible. Treacle will not pass as quickly as water, freight traffic will not pass as quickly as passenger traffic ; but the amount passed through will depend upon the good organizing powers of those in charge who will endeavour to make the speed of all as great as possible.

No executive, whether he be a Prime Minister, a Divisional General, or a station-master, can get the best out of his men without discipline. Discipline can be of more than one kind ; there is the hard variety, the stern discipline without a smile ever apparent, which is supposed

to work wonders, but never in practice achieves anything. There is the kind of discipline which is mainly tact and encouragement, which converts discipline into a high morale. This latter is the kind that is wanted, and it is only acquired by the one in command knowing how to do anything he tells others to do, and knowing why it must be done. The station-master is trained primarily as an outside man, and that is the most desirable training for a railway official; no railway efficiency can be judged by statistics unless one knows how those statistics are compiled. Statistical returns are a closed book to the man without outside knowledge and training.

If one travels frequently over a section of line, it is not difficult to hit on the station which is run without discipline; what are the symptoms of the disease? It will be found that station time is invariably exceeded, and if it is a terminal station trains will leave with wrong destination boards, or without boards at all. Again, it will be found that it requires twice as long as it should do to get a ticket, and very often the booking office is opened so shortly before the train is due that the latter is delayed. Porters are either always in the porters' room, and emerge smoking, or rush to the carriages to seize papers rather than to handle luggage and parcels, while lamps are dirty, flower-beds unattended, barrows all over the platform, and edges never whitened.

The making out of platform occupation lists is very often within the duties of the station-master, although in the case of large stations the working may be arranged at a central office, but in any case improvements and alterations are invariably in the hands of the station-master. To-day suggestions from station-masters, which may result in economies, are ones which seem to meet with the closest attention; but it does not do to be over-zealous in this respect, and the man who waters the ink to make it last longer, who expects pen-nibs to last for twelve months, and who advocates blotting-paper which will not blot, is himself not likely to last so long in his position, if judged by the efficiency of his command. Such trifles as these are false economies, and injure rather than

aid the improvement of efficiency in any organization. The station-master, if he wants to rise, must educate himself, must put in a strong, well-thought-out case for the saving which he considers may be achieved in a cross-over, the lengthening of a loop or dead-end siding, or the alteration in signal positions or train services. He should know offhand the degree to which his seating accommodation in each train is utilized, and the general public feeling in his district towards the railway.

No member of a railway's staff has the opportunity of mixing so often with the all-important general public; he is the railway's public relations officer, and is looked upon as the aristocrat of the locality. His golden rule is to remember that "the public is always right," and if he adopts this attitude his staff will take the cue from him, follow his example, and all become station-masters.

The problems which must be faced by the British railway operating superintendent to-day are manifold, and many of them difficult of solution; nevertheless, the way their solution is attempted is of considerable importance to the country, since its prosperity rests upon a power to compete in markets abroad, and our standard of living must to a large degree depend upon our ability to pay for imported food-stuffs with exported manufactures. Rates and fares are to-day designed to yield a standard net revenue; hence, if costs can be reduced, rates and fares can also be reduced. The operating officer is the man on whom the country must rely for this reduction, but at the same time he must achieve this without in any way lowering the standard of the service he supplies; for if the service should deteriorate, traffic will be lost, and the level of rates and fares tend to rise, in fact a vicious circle will have been formed from which it will be difficult to escape.

British passenger train service is renowned the world over for its high speed and comfort, as well as for the long non-stop runs which exceed in length those of any country overseas, but the losses in passenger traffic revenue since 1925 tend to show that every effort must be made to improve still further our passenger traffic

facilities. For long distances main-line railway service probably remains supreme, and the long-distance traffic has been less affected by road competition than short-distance traffic. On the other hand, the reduction in the community's purchasing power, resulting from the 1926 strike, has forced many to take their holidays at places nearer home than was their usual custom.

To make the maximum use of its available locomotive power, an accurate system of locomotive power classification is essential, in view of the many various types of locomotives now available to each amalgamated Company. The London, Midland and Scottish Railway has developed such a system in a scientific manner, and it is understood that excellent results have attended its adoption. In reference to this problem considerable attention has recently been given to the subject by officials of the Canadian National Railways, the problem having arisen there partly on account of the amalgamation for operating purposes of the Grand Trunk, the Grand Trunk Pacific, the Duluth, Winnipeg, and Pacific, the Canadian Northern, and the Canadian Government Lines, with the consequence that a large number of types of locomotives were in use over the system as a whole between Halifax and Vancouver. The system decided upon was one of power percentages, which allows a very exact loading schedule to be arranged. There are considerable variations within each type of locomotive in use : thus, the " Mogul " (2–6–0) types vary from 17 to 28 per cent. ; the " Consolidation " (2–8–0) types from 30 to 50 per cent. ; and the " Pacifics " (4–6–2) from 29 to 38 per cent. These percentages are painted on the outside of the cab sheets and are therefore clearly distinguishable to all yard staff and others who are responsible for the adequate loading of trains.

A great advantage of the percentage system over the usual 1, 2, 3 or A, B, C method is that with the introduction of larger and more powerful locomotives and the scrapping of older types, the system requires no alteration over a long period of time, the new classifications entering in and the old classifications dropping out without any

alteration to the intermediate scale. Meanwhile, the average locomotive power is increasing year by year. In connection with this system of power classification a system of equated tonnage ratings has been arranged on the following basis : For the main line of the Edmonton Division from Edmonton to Wainwright, for example, the equated tonnage rating is published for the various types of locomotives usually employed on freight trains on this division. East-bound figures are : for a 28 per cent. locomotive, 1,820 tons ; a 35 per cent. locomotive, 2,275 tons ; a 50 per cent. locomotive, 3,250 tons ; a 53 per cent. locomotive, 3,445 tons ; and a 100 per cent. locomotive, 6,500 tons ; the 100 per cent. being given as a basis from which to work out equated tonnage figures for any type not specifically given. The " equated tonnage " is the actual gross ton figure, with an allowance added for car resistance ; the figure to be allowed for car resistance is obtained by means of a car factor, which, in the example taken above, is twelve. Thus, a fifty-car train with a gross tonnage of 2,500 tons, with an allowance for car resistance of $50 \times 12 = 600$ tons, making a total of 3,100 equated tons, would be too heavy for a 35 per cent. locomotive, and would probably be hauled by a 50 per cent. locomotive. Various reductions are made in tonnage, when temperatures are low, or in the case of bad rail conditions ; thus 32° F. to 16° F., or bad rail, 5 per cent. reduction ; 21° to 25° below zero, 25 per cent. reduction, and so forth. Other reductions apply to passenger locomotives being used on freight work, namely 100 tons ; to fast freight trains, 10 per cent. ; and to new locomotives, 20 per cent. on first outward trip.

Without some such accurate system surplus power is bound to be provided on certain trains, and inadequate power upon others, though allowance must be made for a sufficient reserve of power. The tare weight of each passenger train should be studied and locomotive power allotted accordingly, bearing in mind that a sufficient reserve of power should be available for making up lost time, to ensure the lowest fuel consumption, and to enable at least one extra carriage to be added without

altering train working times. On the whole, compared with foreign countries we work our engines beyond their power rather than below their power, that is to say, in many cases, there is not sufficient margin for the above-mentioned eventualities. This has only been made possible by the excellent quality of British coal, but it makes for high fuel consumption and maintenance costs ; on the other hand, it lowers first or original costs, reduces stresses on the track, and lowers the axle load required on bridges. It does, however, necessitate double heading on certain lines, or the duplication of trains.

There are definite schools of operating thought on this question ; with our light passenger trains requiring high speed, and certain main lines restricted to a low axle weight many railway officers believe in the adoption of a comparatively small type of locomotive with low fuel consumption, which can handle a train of 250 to 300 tons with ease, and which can be assisted by another small locomotive in the comparatively few cases where the train has to be made up to a greater tonnage. There are, however, others who maintain that it is cheaper in the long run to possess a more powerful type of locomotive, which although admittedly not working to full capacity on, perhaps, 50 per cent. of the runs it makes, can handle a 500- or 600-ton train if, and when, required. This later policy permits a greater tonnage capacity to any section of line, but it involves difficulties with regard to platform lengths and the provision of larger turntables, and other capital expenditure of a similar nature.

Naturally each case rests upon the degree to which a large engine will be used on trains for which it is unnecessarily powerful, but with the high percentages of total operating cost spent on wages, the use of two locomotives for one train appears to be an uneconomical process, since it must result in much unnecessary light running or, at any rate, additional running, since traffic is not evenly balanced. It may be that British operation is unique in that it requires such a system, but it is clear that all foreign railway operating men look upon such a system as extremely wasteful.

The problem of finding additional paths for passenger trains, especially at heavy holiday periods when maximum pressure is exerted on the rolling stock requirements, makes essential the limitation as far as possible of the number of trains. At such periods the turn round of locomotives and vehicles should be as rapid as possible, and often balanced working may be impossible and one must resort to light running. To attain the maximum degree of track capacity the signal engineer has, in recent years, so improved his science that few additional tracks have been constructed, partially due to financial stringency, but mainly to the fact that the much cheaper alternative of resignalling has permitted a great decrease in track headway, at the same time preserving if not bettering the degree of safety.

The increased use of corridor vehicles has operated in exactly the opposite direction, since it has increased the tare weight per seat and consequently the weight and number of trains. Nevertheless, there are many who look upon the supply of corridor vehicles even for excursion trains as a necessity, and would prefer to stand in them rather than to obtain a seat in a non-corridor vehicle. The prejudice against the corridor vehicle on the part of many railway officials is rapidly disappearing, but its advantage in evening the load throughout a train is still too often forgotten ; by this it tends to cut down station time, and thereby to increase track capacity.

Reduction of loading time at terminal stations at peak periods is most important, and a judiciously arranged system of special barriers, booking offices, or booking in advance materially reduces the difficulties of those responsible for train operation. Not the least of the problems since the amalgamation has been the standardization of brakes, many constituent Companies using the vacuum brake, whilst others used the Westinghouse. The present policy with regard to steam traction coaches seems to be towards fitting all with vacuum, whilst Westinghouse is being standardized for electric traction. When these two types of brake were first invented neither was automatic, and it was not until about 1878 that their auto-

matic operation became a practical proposition. By 1890 nearly all passenger train locomotives and carriages had been equipped, largely as a result of the Act of 1889, which made their application to all passenger trains compulsory.

It is the efficient automatic brake which has made high passenger-train speed possible, thereby increasing the track capacity, but high speed itself is of little value for this purpose if the trains are so light that additional ones

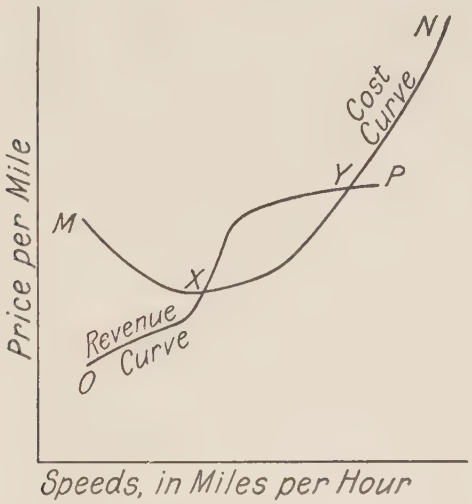

FIG. 19.—Graph showing lines on which attempts might be made to find net Revenue of a Train or Train Service at various Speeds.

If x and y could be found obviously the most desirable speed would be somewhere between x and y.

must be run. Those who cry out from time to time for faster and speedier passenger train service to Scotland, for instance, ignore the elementary principle of economics that there must be one point at which a railway will be able to earn the maximum net revenue from any individual service. If the speed of the train in question be increased, it must be that cost will tend to rise, whilst revenue is very unlikely to rise in proportion (see Fig. 19); if one takes the process farther the time will come when a carriage has to be dropped in order that the speed may be

still further increased, and this will seriously reduce the earning capacity of the train. On the other hand, any train schedule which is continually being bettered is, in practice, one that requires drastic amendment; an arrival before time is just as bad from an operating point of view as a late arrival; it disorganizes traffic equally, if tracks are being operated to full capacity.

Those who urge overall speeds of 70 miles per hour as regular runs forget that under present conditions the British railways have earned, over a long period of years, a reputation for safety second to none, whilst on the side of finance it is undesirable that such costly express services should be subsidized by levies on freight traffic in the form of high rate levels.

Punctuality in passenger train service is of supreme importance. Many a service can afford to be slow if it is invariably punctual, and it cannot be denied that the enviable reputation earned by the British railways prior to the war has suffered somewhat in recent years. Punctuality largely depends upon good organization, the team spirit, and a high degree of *esprit de corps*; traditions of sixty or seventy years cannot be broken with impunity, nor can they be hastily pieced together again like some broken china figure of Hope. The re-organization of the amalgamated railways will require some years to complete, and meanwhile it is to be hoped that there will spring up once more that useful element of competitive *esprit de corps* which will make it a point of honour that the trains must arrive on time. The bad judgment of one signalman at a wayside box may upset all main-line working for many hours, hence it is important for the operating superintendent to analyse his late passenger arrivals, preferably in graph form, so that the prevailing trends may be grasped in a few seconds. Causes of delays and engine failure should also be analysed in the same manner, for without such information the root causes of the financial loss thus sustained cannot be eradicated.

There is no problem which is more in the mind of the operating officer than that of the safety of passengers and employees. The British railways have an envied

record in this respect which is all the more remarkable in view of the high speeds of British trains, a feature which is often taken for granted by the general public. Yet safety can only be obtained at great monetary cost, but this has always been looked upon as a secondary consideration. In 1925 not a single passenger was killed on any of the four groups, and similar records were attained in 1901 and 1908 on the pre-grouped railways, whilst in 1909 there was only one fatal accident. Against 1,000 killed in London streets in 1926, there were three fatal railway accidents; but the next year started inauspiciously with the bad accident at Hull, and the recent Sevenoaks accident resulted in a high total for 1927.

Accidents to employees are more common, and must necessarily be so; but "Safety First" campaigns and strictly enforced discipline are means by which they can be reduced. In night work at a marshalling yard, danger can never be entirely eliminated, any more than can the very occasional failure of the human factor; but in the case of most modern accidents it is a question of the failure of more than one element, in fact a combination of unfortunate coincidences. Heavy capital expenditure would doubtless reduce the number of individual accidents, and it is one of the tragedies of such a financially disastrous year as 1926 that much of such expenditure will inevitably be delayed.

Many employee accidents are caused through carelessness of the injured, such as splinters from steel saws, cuts which remain undressed and so forth; such cases can only be cured by severely reprimanding men who are observed habitually taking such risks. Safety prizes for foremen have been found, in the United States, to do much good in this respect, and the Harriman prize, given to the railway with the best safety record, is an example which might well be followed in Great Britain.

Turning to the safety of trains in motion, it would appear that most reliance must be placed on two factors: namely, the first-rate maintenance of rolling stock and track to prevent such accidents as those due to axle or draw-bar breakage, loosened tyres, and broken rails;

and also the signalling system which aims at setting a space interval between moving trains, except in yard or station limits, when trains should always be under sufficient control to stop clear of obstructions. It must not be forgotten, however, that the signal system also aims at obtaining the maximum track capacity provided that safety can be assured, and the most recent tendency is to achieve these ends with the minimum of human labour.

Further attention should be given briefly to the economic results of signalling progress. The main steps in its progress have been the invention of the block system, the interlocking of signals and points, the development of power signalling and interlocking, and automatic signalling. The most important development of all probably has been the invention of the track circuit, by which a train by means of an electric current passing through the rails can actuate an electro-magnet, which in turn permits the signals to be lowered for another train movement.

Modern signalling tends to rely more and more upon the track circuit and electric power, which, provided there are no human or mechanical failures, is infallible. Operating costs have been reduced by the elimination of signal-cabins through concentration of control at one instead of two or three. Double-direction signalling for one track is admitted to be safe, points may be operated at long distances by electricity, whilst systems of automatic signalling, which were early in use on the London and South Western, and the North Eastern Railways, are likely to be further extended with the growing popularity of colour lights. One of the great difficulties with automatic signals in Great Britain is that so few signal-boxes can be eliminated by their use owing to the fact that stations, crossovers, and sidings occur at very frequent intervals, which necessitates the presence of the human factor in any case.

Of a total passenger train track mileage in the United States of 233,801 miles, no less than 77,000 miles have been automatically block signalled, whilst over 67,000

miles are equipped with non-automatic block signals. Since the end of Government operation two orders have been issued by the Interstate Commerce Commission to instal automatic train control, and stop devices, on a locomotive division. The first order in June, 1922, as amended, affected forty-five railways; by July, 1927, 8,359 track miles had been, or were in progress of being, so equipped, in addition to 3,700 locomotives. The second order, in January, 1924, was estimated, like its predecessor, to involve an expenditure of $25,000,000. It affected a second division in the case of thirty-eight railways. Automatic train control is unlikely to make much headway at present in Great Britain; the United States has attempted to take a short cut from the despatching system to automatic train control, and to miss out the intervening stage of complete lock and block upon which so much has been spent in this country in past years. On the Great Western Railway there has been in use for many years a system of cab-signal indication, whilst in France the various railways are adopting as standard under Government order, the Nord " crocodile " system of cab-signal indication. It is noteworthy that of two recent accidents in this country, one occurred with automatic signals, while the other could not have been prevented by automatic train control.

The coming of the colour-light type of signals may be legitimately considered as an operating problem, and therefore may be discussed at once. Amongst the advantages of the colour light signal as compared to the semaphore are its position on a level with the driver's eye, namely about 11 to 12 feet above the ground; the fact that it gives an identical indication both by day and by night; its better indication at twilight and further penetration power in time of fog. Added to these are its lower maintenance charges, more reliable operation in driving snow, and its occupation of less space; but the disadvantages of glare and lack of indication to permanent-way workers or station staff employed on its farther side, coupled with the greater difficulty of seeing its indication when on a level with it, have not been entirely overcome.

Colour lights are used exclusively on the Underground, and have lately been used with conspicuous success on the Southern Railway. In France the Paris-à-Orléans has installed them recently. In the United States they are rapdily becoming very popular, where they are installed on no less than 7,442 route miles ; in addition, the position-light signal is employed extensively on the Pennsylvania, and the Norfolk and Western Railways and the colour position light type on the Baltimore and Ohio. Thus the colour-light type of signal is coming into increasing favour, and in certain cases has actually replaced the automatic semaphore type. One of the most notable conversions has been that of the Illinois Central, which efficient line has actually abandoned the distant or permissive signal indicator in two of its latest automatic train-control installations.

The problem of simplifying signal indications, both of the semaphore, colour light, and colour position light types, is one which must be solved in the near future, and will be no easy matter in view of the many indications required under the despatching system still mainly used in America. The Illinois Central has also equipped 20 miles of double track with colour-light signals for both direction traffic, which permits intervals of 1 mile between trains and, consequently, there is no normal direction of traffic, trains moving with equal ease in either direction on either track. The increased capacity of this double-track section has amply paid for the capital expended. A somewhat similar position exists on the Chicago North Western, where the centre track of three is used for west-bound trains between 10 a.m. and 2 a.m., and for east-bound trains from 2 a.m. to 10 a.m. A similar system has existed for years between Bermondsey and London Bridge.

The Baltimore and Ohio, and the Detroit, Toledo, and Ironton Railways have adopted colour position light signals, which although giving only four fundamental indications are designed to show five additional modifications. On the Florida East Coast Railway alternating current colour-light signals are placed every 1·6 miles,

and stand 15 feet above rail level ; on a piece of straight level track two signals ahead can sometimes be seen, though the normal range is just under a mile.

All this signalling progress has tended to relieve the difficulties of the operating officer, and has from the social viewpoint been important in that it has obviated heavy capital expenditure, the interest on which must be derived finally from rates and fares.

An aspect of passenger-train working which is very important is that dealing with the movement of parcels, fish, mails, and milk, which may be included under the combined title of passenger-train traffic. The revenue derived from parcels traffic, including payments by the Post Office for the haulage of post-office parcels, and inclusive of excess luggage charges, was nearly £10,500,000 in 1925 on all the railways of Great Britain. Other merchandise by passenger train brought in a revenue of £5,800,000, whilst mails revenue totalled over £1,750,000, making a net total, after deducting expenses of collection and delivery, of not much less than £15,250,000, or almost one-sixth of the total passenger-train receipts, although this latter includes the receipts of the London electric lines which do not carry milk, and obtain little other than purely passenger revenue.

The British railways have long paid considerable attention to the development of this traffic requiring rapid service, since much of it is of a perishable nature. Even during 1926 almost 250,000,000 gallons of milk were handled on the home railways, with an average receipt of about 1·45 pence per gallon. Such service seriously complicates the task of the operating officer, and it has been the policy of certain lines to develop long-distance trains, conveying milk only, to supply the London demand. Strong competition for this traffic is being experienced from road-carrying interests, but for the long haul the rail appears to hold the advantage. The efficiency of such working may be measured by the distance of the supplying areas, and in the case of fresh milk, this is up to 200 miles, whilst for fish it stretches not only from Aberdeen and further north still, to London,

but from Aberdeen to Dover and then by the Nord and Paris-Lyon-Méditerranée systems to Paris and Marseilles respectively.

A problem of great difficulty remains to the operating officer, namely, the difficulties to be faced in cutting down expenditure on branch lines which carry little traffic, and how to convert them into paying propositions, but this question will be discussed briefly in Chapter XIII, dealing with the question of competition from other forms of transport. It will not be denied that the acuteness of this problem of economical branch-line working has been due to the advent of road competition, for the loss of even a small percentage of traffic in such cases will convert a small margin of profit into an important margin of loss.

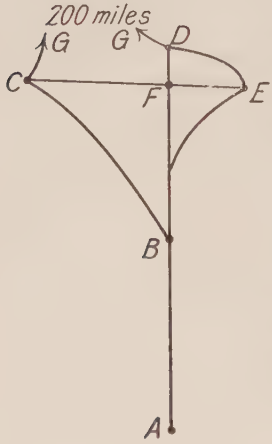

Fig. 20.

The following is a typical operating problem of this nature: A is a very large city. B and C are market towns. D and E are important ports. F is a small wayside junction. C E crosses D B by an underbridge, with platforms on the two levels, with a long connecting bridge. An important express at 8 a.m. from C to A is delayed at B through having to await a second half, consisting of a semi-fast from D to A, which is tightly booked from D to B and must await a connection from G and therefore cannot start earlier. Consequently, it creates much delay to dense traffic near A.

D B is primarily delayed at F by picking up perishable traffic for B and A, which has originated at stations between C and F; it is essential to pick up this traffic as it would otherwise go by road. This traffic arrives at F on a train from C to E, which in turn has awaited a connection at C from G, five minutes before train D B is due.

F has a very small staff and cannot handle this traffic quickly enough by means of a hand-operated lift. To eliminate delays and financial loss through late running of C B A either :—

(1) extra staff must be employed at F simply for this one five-minute period, or

(2) a power-operated lift be put in at a cost of £100, or

(3) the delays may be permitted to continue.

Bearing in mind the impossibility of getting accurate data of the financial loss and lowering of morale caused by continued late running of C B A which is the right policy to adopt ?

Expressed in economic terms, there must be many branch lines in Great Britain operating on the margin of rail production service ; but whether it be socially desirable that such lines be subsidized from the profits of more important traffic lines is open to question. The tendency to-day would seem to gravitate towards a position where the profit of one line should be utilized to cover the inadequate earnings of its less fortunate neighbour ; such certainly was the intent lying behind both the Railways Act of 1921, and the Transportation Act of 1920 in the United States.

The relationship of speed to earning capacity has been already discussed, but it would be inadvisable to close this brief summary of passenger-train working without some mention of the present tendencies. The year 1927 has seen notable increases in the length of non-stop express running ; on the London and North Eastern Railway the long non-stop run to Newcastle, 268 miles, held the world's record during the summer, thus displacing the famous record of the Riviera Limited, whose run to Plymouth, of 226½ miles, in 247 minutes, has done much during the last two decades to raise British railway prestige in foreign countries. For the first time also the London, Midland and Scottish Railway ran their " Royal Scot " express from Euston non-stop to Carnforth, 236¼ miles, but contrary to usual practice the coming of the winter tables bettered the summer exploits and produced a regular non-stop run to Carlisle, 299 miles, on the

L.M.S.R. (Western Division), and a still greater speed on the "Cornish Riviera Limited," which is now scheduled to perform the 226½ miles in 240 minutes.

Such developments show that the British railways still stand in the forefront of passenger-train operation, and there is ample justification for such running in the added comfort provided for the passenger, and the reduced-time occupation of main-line tracks thus achieved. It is to be hoped that the decrease in station time will inevitably lead to a shortening of journey time to the Scottish cities from London; but if such a development is likely to place undue strain on locomotive crews and cause additional heavy cost, it would be economically and socially undesirable.[1] The sound tendency is to aim, as previously mentioned, at a speed which will bring in the maximum net revenue, and this can be worked out graphically by means of supply and demand curves on the bases of cost and revenue at varying speeds. Comfort has greatly increased the tare loads of trains, and there comes a point at which to increase speed, seating capacity, in other words earning power, must be reduced.

The rebirth of the Pullman car system in Great Britain for day travel has created serious difficulties for railway managements and the incidence of double profit, for net revenue is presumably attained by both the railway and the Pullman Company, is probably a retrograde step in economic progress, for it makes one of them an unnecessary middleman. The re-introduction of the Pullman has created in practice four classes of passengers on certain trains, a feature to be deplored as adding additional cost and disorganization. On the other hand, to the individual the Pullman has undoubtedly satisfied a certain want, such as on boat trains and to provide restaurant facilities, but the cost of providing that satisfaction should not be obtained from other sources. It is striking that passenger revenue has held up equally well in the railway areas that have not adopted the Pullman service.

[1] The cost of stopping and restarting a passenger train is estimated to be about 3*s*. 6*d*.

It is realized that there are many interesting phases of passenger-train operation and service with their economic aspects which have been inadequately discussed in this chapter, already long, but it is hoped that a general impression has been given not only of general working of passenger-train operation, but also of the wider field in its effect upon social organization.

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CHAPTER IX

THE ECONOMICS OF FREIGHT-TRAIN OPERATION

It is first advisable to consider briefly the main characteristics of freight-train service as compared with passenger-train service which has just been discussed. Freight-train operation is complicated by its irregular nature, the variation of tonnage movement which is to a large extent seasonal, its lack of standard speed, and the lack of balancing traffic. Consequently, freight-train operation in all countries involves much empty haulage, and suffers from the fact that it has to give way to passenger-train traffic, thus complicating the close adherence to a schedule made sufficiently intricate by the difficulties already enumerated.

The tendency to the increase of small consignments rather than large ones has greatly increased the operating costs of railway freight movement. This tendency may be traced primarily to rapidly changing price levels, and, consequently, the desire to reduce storage to a minimum, and also to the better transport service, not only of goods but of orders by telephone, now available, whereby one can rely upon receiving goods with regularity. A further feature of freight-train service is its inarticulateness. If a passenger misses a connection or suffers an unwarranted delay, he is usually articulate as to its cause, but not so with a consignment of freight. The only result in this case is a complaint or claim for damage with no indication as to where the delay or damage occurred ; often it is difficult for an operating superintendent to discover where this took place. Lastly, the freight must be loaded and unloaded, and in Great Britain the wagon in which it is placed often sheeted as

well. A distinctive feature of British railway freight service is the large use made of the open wagon with sheets, instead of box or covered wagons as used abroad. Both on Continental railways and on American railways the proportion of covered vans is far greater than at home, as is shown in Table XI, and may be due to the large percentage of port work involving crane unloading and loading which is required of a British wagon. At the same time such a system tends to increase claims for damage by weather and from pilferage.

TABLE XI [1]

1926.

Railway.	Covered.	Open.	Railway.	Covered.	Open.
G.W.R. .	37,122	58,825	Germany	208,357	408,904
L.M.S.R. .	77,954	244,471	Nord (France)	49,865	60,447
L.N.E.R.	57,520	223,311	Belge Nationale	39,407	82,561
S.R. . .	8,256	25,835	Swiss Federal	21,168	14,848

In studying these figures it must be remembered that the mineral traffic in Great Britain, except in the North-Eastern Area of the London and North Eastern Railway and in portions of Scotland, is mainly carried in privately owned wagons, the figures for which are not included.

Turning to a consideration of the movement of freight, the first service rendered by a railway is that of cartage to the freight station. The collection and delivery service of the British railways developed from an early date, and has gradually come to be regarded as a natural function of a railway. Abroad it is regarded from a very different angle, but with the growing attention paid to road competition many railways in foreign countries are realizing that to compete on a fair basis, a co-ordinated service of cartage and delivery, together with the rail haul, is essential to meet the offer of door to door service by the road motor haulier.

[1] *Bulletin of L'Union Internationale des Chemins de fer*, August and September, 1927.

The charges problem raised by the collection and delivery service has been discussed in the earlier chapter dealing with rates, and it is not proposed to enter into a long discussion of cartage organization here, but the following figures suffice to give some impression of the important work carried out by this branch of railway activity. In the four weeks of February, 1925, Nine Elms (London) S.R. carted no less than 13,728 tons of goods by horse vehicles at a cost of 10*s.* 6*d.* per ton; and 10,554 tons by petrol vehicles at a cost of 6*s.* per ton. Broad Street (London) L.M.S.R., during the same period carted 29,850 tons by horse vehicles at 5*s.* 9*d.* per ton, and 3,274 tons by petrol vehicles at 4*s.* 1*d.* per ton. In August 1927 Nine Elms dealt with a total of 85,795 tons in all, and Broad Street with 44,327 tons.

The problem of the employment of motor vehicles rather than horse drays is one primarily of road rather than of rail economics; in fact, in the cartage department the railway becomes a road haulier, and this is probably the most important theoretical objection to the railway cartage system as such. The social aspect hinges mainly upon two considerations—that of road congestion, due to horse haulage, in large cities, and to the undesirability of subsidizing a railway cartage service, thereby offering a premium on inefficient management. Provisions of the Railways Act of 1921 should do much to prevent, so far as legislation can, any probability of the latter taking place in the near future. Assuming the arrival of the freight at the freight station, of what design is the latter to be? The answer, naturally, must depend upon the type of work to be done, and for our purposes freight stations may be divided into four main types: firstly, the large terminal station where the traffic is almost all outwards or inwards, of which one might quote as an example, Bishopsgate (L.N.E.R.), Paddington (G.W.R.), Broad Street (L.M.S.R.), or Nine Elms (S.R.); secondly, the ordinary city provincial station, where in addition to inwards and outwards traffic there is a certain amount of transhipment or transfer traffic; thirdly, the pure transhipment or transfer station,

of which Crewe is one of the most famous ; and, fourthly, the freight shed of the wayside station. Unfortunately, almost without exception all freight stations in this country are having to cope to-day with traffic far beyond what was visualized when they were built, with the obvious result that costs of handling are heavy.

The problem, then, which faces us is really twofold : namely, how to get the maximum throughput of traffic at a freight station, and what considerations should receive most attention when a station is reconstructed. In this latter case it is normally true that little extension of ground can be obtained, and improvements must be effected by better design, labour-saving devices, and if necessary double-story accommodation. It will be most convenient to take these two considerations together, as they dovetail into each other very closely. Where there is sufficient space it is desirable to keep certain lines for off-loading or inwards traffic, and certain lines for loading up or outwards traffic. This enables both to go on simultaneously, which is a saving absolutely incalculable in times of congestion. It must be remembered that under ordinary circumstances the delivery traffic leaves the freight station by motor or electric lorry, or by horse dray about eight o'clock in the morning, and the drays start returning with collected traffic by one or two o'clock in the afternoon. Depending on the distance travelled, the lorries and drays make one, two, or even three trips per day.

In addition to cartage and delivery by the railway, space must be left on the inwards benches for traffic waiting to be called for by the traders. Where this forms a large percentage of the total, it is especially desirable to have separate inwards and outwards lines. However desirable it may be to separate inwards and outwards traffic, in nine cases out of ten lack of room prevents this, and, as a result, the unloading must be completed before loading is started. Though it is hard to generalize, the usual system is to off-load during the night so that most of the goods are already on the lorries and drays by the time the delivery men arrive in the

morning. A certain amount of clearing-up work has still to be done on the off-loading side, and then the inwards lines are drawn out and empties put in so that loading can commence as soon as the first outwards traffic arrives.

In certain cases the empties made can be utilized for loading, but in this case certain wagons of unsuitable types have to be left empty and this is highly undesirable, for it tends to increase congestion by unnecessary wagons blocking up bench space, and over each wagon position should hang a label showing the destination of the wagon standing under it each day. Labels are better than symbols, as they are clearer to men unaccustomed to the work. The traffic for one destination may vary considerably from day to day and, therefore, the labels should not be permanently fixed but should be movable or slide along wires. These labels should be well illuminated at night and kept freshly painted.

Whether goods are stacked on the benches opposite the empty wagons, or loaded straight into them when unloaded from the drays and lorries, depends upon the times of arrival of the outwards traffic and whether separate lines can be used for inwards and outwards traffic. If they can be loaded straight into the wagons, a second handling with all that that means in cost and risk of damage is eliminated; but, on the other hand, the stowing is more difficult, as the loader cannot tell what further traffic is to come. This latter difficulty is especially true of "road" wagons, which must be loaded in accordance with the position of each destination station, and the side of the wagon from which goods are to be off-loaded. An important problem arises with regard to whether a station should be designed with through lines or dead-end lines. The tendency is for large terminal stations to be of the dead-end type, while transhipment or transfer stations are usually of the through type. If the station is of the through type, goods must be wheeled through wagons, which as a result cannot be loaded whilst this is being done; or movable platforms fixed across between every ten wagons or so. This latter

system is somewhat dangerous, but it saves the long barrowing distance which is bound to occur with the E-shaped type of dead-end design station. In any case the movable crossings or wagons used as such take up considerable room in any freight station. A third alternative is the overhead crane, but that is not suitable for handling every kind of commodity and can only handle one load at a time. In addition it is not always favoured by the staff, as they find the constant watching to see that loads are not dropping off a great annoyance.

Benches should be about 30 feet wide, and, where possible, a desirable length would be about 250 feet long, if the shed be of the dead-end type. Supports for the roof should be between the lines and not on the benches, which should be smooth but not slippery, absolutely level, and preferably of concrete. Slightly higher than the wagon floor on the loading side and slightly lower on the off-loading side makes for speed. In some cases wagon turntables are employed for internal shunting in freight stations; often these are worked by capstan or electric power. There are, however, many disadvantages to this system. For instance, semicircular pieces must be taken out of the benches to permit the wagons to turn, also wagons vary in length and consequently turntables cannot be replaced as the average wagon size grows, whilst it is difficult, if not impossible, to turn bogie wagons. But the most important disadvantage is the fact that any movement of one wagon will upset two lines at least and cause valuable loss of space. At the same time there are certain advantages; namely, the clearing out of wagons loaded or empty earlier than the others on that line. The disadvantages as a whole outweigh the advantages, and so far as is known these turntables are not being included in the equipment of any new or reconstructed freight station, save for exceptional cases.

The second type of freight station is that which has to handle transfer or tranship traffic. This should be dealt with at the centre bench, and it will probably be

necessary to wheel through other wagons to avoid the long-bench haul.

To turn to a study of the transhipment shed. It is not intended to discuss the position on a railway where transhipment or transfer sheds should be situated. York, Doncaster, and Crewe give one sufficient clue to the type of place where such a shed should be established. The main underlying principle is to establish transhipment stations at points which make distribution over wide areas easy, and to which it is normally possible to obtain sufficient traffic to justify a full wagon-load. If there are too many transhipment sheds they defeat their own object, because they make it more difficult to make up a wagon-load; whereas if there are too few transhipment stations the average wagon-load will be lighter than it might otherwise have been. The main theory of transhipment work is that certain stations should be supplied from one centre point so far as less-than-wagon-load traffic is concerned, and thus it may be possible for some station to load a wagon fairly well each day to T, the transhipment station, since that wagon may contain goods for fifty different stations, whereas the alternative might be that one would have to send many light loads.

Fig. 21.—Lay-out to demonstrate Working of Transhipment Organization.

To take an example as set out in Fig. 21, S supplies all stations in its area, T supplies all stations in its area. If J had some goods, say 5 cwt. for N, it would send them to T with all its other goods for T's district. If these were not sufficient to form a wagon-load to T, they would be sent to S first, where they would be formed into a wagon-load for T, from whence they would be worked on to N by wagon-load or road wagon. In the case of a station at K there would be a certain amount of back haul, but against that one must weigh the advantages of a better service being offered for the average con-

signment. The transhipment system does yield an increased service undoubtedly for small consignments, which is highly desirable in these days of strong road competition.

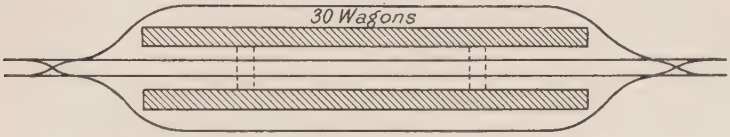

Fig. 22.—The Design of a Transhipment or Transfer Shed.

In such a conjectured case one might provide space for thirty wagons on each line. There would be movable platforms, 12 feet wide, between the two benches, which should be at least 30 feet wide, because the goods must be stored on the benches during the time between the wagons being off-loaded and loaded up again. As in the case of the terminal, it may be necessary to draw the wagons out if unsuitable wagons arrive under load, in which case they would leave at one end and enter at the other.

To obtain efficiency equal attention must also be given to the outside yard facilities. In the case of the terminal freight station and of the transhipment shed, the general working principle must depend very largely on outside track lay-out, and yard facilities. Usually the transhipment shed is better off in this respect, since it is nearly always situated in close proximity to a marshalling or classification yard. Many of our largest and most important freight stations possess practically no outside yard facilities at all which makes replacement of empties by loads or vice versa extremely difficult. Bishopsgate (L.N.E.R.) is probably one of the worst examples in this respect. The system of providing separate arrival and departure lines to each station track is especially desirable in such cases.

Before dealing with inside working one may turn briefly to the design of the goods shed at the wayside station. A typical small goods shed of standard design might consist of a covered area perhaps 60 feet long by 30 feet wide, and an open bench about half as large

with the roof extended to cover two or three wagon-lengths of line together with mobile crane facilities so arranged as to operate under cover or in the open. The problem of cranage is a vexed one, and expert opinions vary very much as to whether cranes should be fixed, movable, or should be shared between two stations: such a problem can only be answered broadly and must necessarily be decided on its merits for each individual case.

Having now mentioned successively, but briefly, the aims of design and general lay-out of the four main types of freight station: namely, the city freight terminal station; the city terminal which also deals with transhipment traffic; the pure transhipment station; and the wayside freight shed, the inside working and methods of such stations should engage attention. Taking our types of stations in the same order, it is, perhaps, best to start with the arrival of the freight on the dray or lorry. The tare weight of the road vehicle is always painted upon it, so that by weighing the dray or lorry on the weigh-bridge at the entrance to the freight station, it is possible to find the total weight of the load. During this operation each consignment must be numbered successively. The dray or lorry is then backed against the unloading bench, and if no demountable flat or container system is in use the horses can be taken out, and hitched on to a delivery dray if there are any waiting. With mechanical transport it is especially desirable to utilize the demountable flat or container system because the power unit is a more expensive one and should not be kept standing idle.

The present trend is clearly in favour of container working in one form or another. The container in its simplest form is a type of box into which goods may be loaded, the whole container being transported from door to door and removed from the railway wagon either by crane or sliding ramps or wheels. It is the natural corollary to strong road competition. Another phase of the same idea occurs in the use of demountable bodies for motor lorries as used by the Chicago, Milwaukee, and

St. Paul Railroad at Milwaukee. In practice these bodies are unit containers and are transferred from the chassis by means of steel ramps on which run rollers fixed on the underside of the body. By this method a lorry driver can pick up a loaded container, take it away and deliver it without leaving his seat. A further variation is the tractor-trailer system, very popular in the United States. By 1927 the American Railway Express Company was transferring 1,800 loads per day by means of forty-five tractors and 105 trailers in Chicago.

The size and composition of the unloading gang must necessarily vary with local conditions, but at nearly all important stations it is the custom to have a " caller off," or " checker," in addition to the actual porters of the gang. The checker compares the goods off-loaded with the consignment notes, as well as looking after the weighing of each consignment, for the weight must be entered accurately on the consignment note, and he must also see that the labels are clear and in good order. For goods not included on the consignment note, special notes must be made out, and as this creates much extra labour every endeavour should be made to keep the percentage of these in proportion to the total as low as possible. Those notes without charges written in are quite common with the " carriage paid " variety of goods and special care should be taken with these.

Any cases of bad packing should be noticed at once, and, if really bad, should be returned to the sender as unacceptable by the railway. To improve this state of affairs the American railways have recently arranged courses for traders' employees responsible for packing goods ; this is an example which British railways might follow, but here there is no Government department corresponding to the Forest Products Laboratory of the American Government, which has given great assistance to this policy by researches into the best methods of packing and the reduction of claims. The only charges made are those just sufficient to cover the cost of materials used.

In all modern freight stations where the benches are

wide enough, electric or motor trucks are used, which are capable of taking four or five trailers as well. Where benches are narrow and obstructed with pillars and cranes reliance has still to be placed on the man-handled barrow, but it is a long and tedious process. At Southampton Docks, the Southern Railway has adopted an ingenious type of electric truck, which is designed on the lines of the demountable flat. Goods are loaded on to a platform standing about 1 foot from the ground, leaving a hollow underneath except for four legs; the electric truck chassis arrives to remove the platform, which it effects by pushing the chassis under the platform and then lifting the platform off the ground.

At the London, Midland and Scottish Curzon Street freight station [1] at Birmingham, electric trucks 7 feet by 3 feet 4 inches and with a carrying capacity of $1\frac{3}{4}$ tons are in use with great success, on asphalt benches 12 feet by 140 feet. It is claimed that these trucks take up much less space than the old hand-barrows and possess a hauling capacity of 4 tons. They result in a saving of labour and energy and in a reduction of claims, as goods can be stacked on them better, largely because there is no tilting and less of the goods are spilt. Two batteries are used per truck, one being charged whilst the other is in use; batteries are removed from the trucks by an electric crane. The financial success of these trucks depends on their being in constant use, since their first cost is heavy. It is curious that the trucks, instead of cutting up the asphalt on the benches, tend to iron it out. They are popular with the staff, as they reduce fatigue, especially in hot weather.

Labelling should be done directly the goods are off-loaded from the road vehicle, and in many stations it is arranged that the staff working on the consignment notes make out the "tie on" and "adhesive" labels. The name of the sending station is printed on each label, while the name of the destination station should

[1] "Working of General Traffic in Goods Sheds by Electric Trucks," by T. H. Shipley, *The Journal of the Institute of Transport*, March, 1925.

be typed. All writing should be abolished on railway forms as far as can possibly be done; it makes for illegibility and lack of standardization, and is often the original cause of delay and loss. If the goods are loaded direct into a wagon, the number of the wagon must be brought back to the checker to mark on the consignment note; but it is more usual to load up the wagon at a later time, the goods temporarily being stacked, in which case a checker will work at the loading point in conjunction with a "caller off."

The most desirable ideal is to obtain a full wagon-load, but to hold traffic twenty-four hours to attain this object is to disregard the viewpoint of the trader who, if he sees his traffic left over-night, will complain of delays, forgetting that by holding such traffic over a railway might be able to hasten transit time by obtaining sufficient traffic to load a direct wagon. The nominated loading system, which informs traders that a direct wagon will be sent, for example, to Pepperhampton on Mondays, Wednesdays, and Fridays, is a somewhat dangerous one to employ in these days of road competition. If a full wagon-load cannot be obtained the first alternative is to load a mixed wagon, consisting of consignments for the destination station, made up with goods for transhipment at that station. A second alternative is to load a wagon for the transhipment station in which area lies the destination station. Transhipment service is expensive, and it is popularly supposed that on an average goods take one day longer passing through a transhipment station than if they are sent in a direct wagon. This is a serious matter, for the average haul, for merchandise traffic was roughly 87 miles for all the railways of Great Britain in 1926, and it is a subject for concern if one has to tranship goods travelling such a comparatively short distance.

The question which is constantly arising on every railway is that of balancing the advantages of utilizing a transhipment service or sending a light load through to destination. Unfortunately the position of *cæteris paribus* never exists at more than one time which necessitates that calculations be made afresh at frequent intervals.

Against the advantages of a tranship service one must reckon the cost of transhipment, the cost of the added delay to the wagon, the cost of extra tranship sidings and sheds, and the time and labour involved in checking the consignments. The alternative system, however, involves increased costs due to the additional wagons required and their maintenance, the added cost of haulage, and enlarged marshalling yard space and sidings. It is unfortunate that road competition should inevitably tend to enforce a lower minimum load, which must equally lead to a rise in the cost of movement per unit.

The method for testing the time of transport usually employed is that of the "journey time slip," which is often used for one week of each year, and if comparisons are to be made with other years it is advisable to keep to the same week if possible, such as the last week of May, since the types of traffic, congestion in a given area, and other conditions, vary greatly with the different seasons of the year. The "journey time slip" consists of a "tie on" label, attached to each consignment. The despatching, tranship, and destination stations, all mark the time on the "journey time slip" as the package passes through their hands. These slips are detached before the goods are delivered and are sent to the head office for checking and statistical purposes. It is from the study of these "journey time slips" that improvements in freight-train service may be designed. This is especially important to-day, owing to the heavy competition by road vehicles and the gradual but steady shortening of the working day to eight hours in most trades. The latter has had a great effect on freight-station working, since it has tended to make later the hours for delivery of goods in the morning and has shortened the time during the afternoon at which they may be collected. Naturally, it has also increased the cost of personnel for handling the goods, whether of the outside or of the inside staff.

The minimum weight of a wagon-load varies from 1 ton to 2 tons, and, of course, is better at the higher figure; but the problem of cubic capacity as well as

tonnage weight must enter into considerations of this kind. The transhipment wagon-load principle is not simply to obtain a wagon-load which contains goods for many destinations, but to obtain a wagon-load which contains goods for many destinations, all of which can be conveniently served from one central position, which is the arrival transhipment or transfer shed. Transhipment work does not differ greatly from that of handling ordinary traffic. One may take as a good example of well-regulated transhipment work, that used at Crewe, where invoices are collected and taken to a sorting office. Here each loading berth is numbered and is represented by the same numbered peg. As the invoices are brought in, they are marked with the number of the berth to which the goods are to be sent for loading, and are then sent to the unloading checker for whom they serve as a guide for the disposal of the goods, the packages themselves being marked with the number. As the unloading is completed, the invoices are returned to the sorting office and hung on the peg of which the number corresponds with the loading berth to which the goods have been sent; here they wait until the loading checker is ready to use them; the latter is in this way enabled to obtain all the invoices for one berth from the same peg. Entries concerning transhipping details should be typed on each invoice as it passes through the sorting office. Details for goods for which no invoices have been received are typewritten on special forms to distinguish them from those for which invoices have been received.

The fourth alternative system of loading is the use of a "road wagon," which is, on certain railways, given other names. These wagons contain goods to be unloaded at, perhaps, ten different stations between junction points, and convey what one might term package freight, or smalls, which it is impossible to hold up until a wagon-load can be obtained. The "road wagon" is handled by pick-up freight trains, stopping at every station, and the goods for each station are unloaded from the road wagon while the train stops at that place; the unloading is usually undertaken by the station staff. Goods

from each station are normally loaded into the road wagon at the same time, thus it may arrive at the train-destination station as fully loaded as when it started. One or two railways have attempted to combine the guard's van with the road wagon, which is nearly always of the covered type; but such a practice has disadvantages, such as the position of the van at the end of the train when the train is shunted to allow other trains to pass. It will be clear that there are distinct limits to the amount of traffic that can be handled by this method at any one station, if the pick-up freight train is not necessarily going to be held back to allow for unloading. Freight must be loaded in these wagons in very carefully arranged order, and the doors on both sides, if both sides are to be used, must be kept reasonably clear. An overloaded wagon from this point of view may cause very heavy traffic delays.

The possible fifth alternative is to load a "composite" wagon which contains freight for two adjoining or near-by stations, for which the traffic, being individually insufficient in each case for a direct wagon, warrants a full wagon-load to the first station and the sending on of the remaining freight in the same wagon to the adjoining station.

At the destination station the invoices are collected. They may have arrived under the care of the guard of the train, or have been nailed to the wagon, a very crude, inefficient, and undesirable method, or in certain cases they may have been despatched by passenger train so as to arrive before the freight train in question. The delivery clerk checks the wagons and chalks them for the lines he wants them put on, wagon-load traffic being generally handled by the trader or consignee, and usually placed in the yard, or on a private siding.

Wagons in the freight station should be unloaded so far as possible as they arrive in order to prevent accumulation. Every two hours the yardmaster or station agent, as the case may be, should have some kind of statement showing that the freight is being unloaded roughly at the same rate that it arrives. The unloading checker then takes over

the invoice for the wagon he is dealing with and directs the stacking of the traffic for various districts of the town in question, after seeing that the goods have not been damaged and tally exactly with the invoice.

With regard to the organization of the unloading and loading gangs, it is impossible to generalize on this question, but the main principle is to insure that the work is evenly divided so that the checker is not continually waiting for the porters or the porters too many in proportion to the checker. If the desired ratio cannot be arrived at successfully, then the least skilled should be the one to whom the surplus time should be allotted. His value per hour is less and his physical fatigue probably greatest. A normal-sized gang may be taken as consisting of one checker, one loader or caller off, and four porters. The gangs are supervised as a rule by the various bench foremen, or direct by the shed foremen, while the general working, often of the yard work as well, is under the supervision of the freight station agent or superintendent. Wages payment methods are various, but, in many cases, both the gangs and the Company prefer some kind of bonus system in addition to the basic rate of wages. Thus, a premium bonus system has been adopted, sometimes on a tonnage basis, in other cases on the wagon loading basis. This applies at most of the large freight stations and some of the small ones, both for handling and cartage staff, but the men are usually guaranteed a day's pay irrespective of the amount of traffic handled.

Neither can be a very accurate system of measurement and care must be taken to give each gang equal chances of obtaining the bonus wages. Usually this is arranged for on a rota system, each gang moving on to the position of the next gang each succeeding week. In some stations it is the custom to post up, each week, the tonnage handled by each gang; such a system induces a spirit of friendly competition, but if carried too far leads to jealousy and friction between the gangs. All the best systems of premium bonuses are, however, based on the work done by the gang and not by the individual; this

ensures that each gang is keen on getting rid of a slacker at the first opportunity. The most important feature of any bonus system—and this applies to all piece-work wage rates—is that no attempt must ever be made to reduce the wage scales if high wages are being earned. Too much of this so-called economy has been common in British industry during the last fifty years, and the country is reaping its harvest to-day in the antagonism of the trade unions to piece rates and the friction between employer and employee which cannot be hidden from any intelligent observer to-day. Co-operation between the two is essential for the prosperity and success of either, and careless handling of goods arising from lack of sympathy between the two is productive of heavy losses to both.

Any figures as to the cost of handling would be somewhat misleading, as no freight station can be termed "typical"; but a few facts about the new freight station at Bristol on the Great Western Railway may be of interest.[1] At this station 500,000 tons of local freight traffic are dealt with per year in addition to 75,000 tons of transfer traffic. This works out at about 500 outwards and 350 inwards wagons per day, the latter containing 10,000 consignments. The inwards transfer consignments amount to 2,000. The old station possessed a wagon standage of 432, of which 242 were under cover; the new station has a standage of 748, of which 408 are under cover. It is of the E type, with eight benches 30 feet wide and having two tracks between each, and a circulating area 40 feet wide. The height of the benches is 3 feet 6 inches; and they are connected with "tip-up" balance bridges. Electric trucks of the elevating type are in use in conjunction with trays or stillages. Mobile petrol electric 2-ton cranes do the heavy handling. A 10-ton electric travelling gantry is in the yard. Twenty-six electric capstans are provided and 20-ton twin cant weighbridges.

Two of the most important innovations in the handling of equipment are the substitution of electric trucks and

[1] F. W. Lampitt, "The Great Western Railway Goods Depôt at Bristol," *Journal of the Institute of Transport*, February, 1927.

trailers for two-wheeled barrows operated by man-power, and the introduction of cost or performance sheets showing the total tonnage and cost per ton, the total cost of man-hours and money. The gang system involved two if not three distinct operations and required an empty back haul to the road vehicle. By the introduction of the elevating four-wheeled truck manually operated, improvements were made and two operations were combined. The receiving and the tallying is performed in one action, but when the electric truck and tractor became available still further economies were effected. The original advocates of tractors were convinced that a minimum haulage distance was essential, this distance being 300 feet, but this theory has been disproved in practice. An average haul of 85 feet is ample. The best results from tractor operation can only be obtainable by their 100 per cent. use. The whole problem is essentially a railway problem in miniature.

It is intended now to deal with the general problem of freight-train service, and, firstly, with the economic principles involved. Unlike passenger-train operation the freight train does not necessarily run if insufficient traffic is offered. The passenger train cannot be cancelled at a few minutes' notice, because, if a passenger service appears in the public time-table, there is an obligation to run that service ; but with freight one knows some time ahead what will be available for transit, since loading must be effected, and, therefore, there is time to cancel a train. There is no public freight time-table, though the German Railway has recently published a time book showing the probable time of transit between all the most important stations in Germany. With freight service the operating staff cancel the train if the load is insufficient, but there are many factors which should be considered before such a decision be taken, such as the effect upon the receiving station or yard, the effect upon stations where the train would normally stop to drop or pick up wagons, and also the problem of the balanced working for the engine, and the train crew, and in certain cases the return working of the brake van.

The second very clear difference from passenger traffic is the problem of classification. Freight is classified according to the freight-classification book; it pays a high rate, generally speaking, if it is an article of considerable value for its size, or if it is perishable, and consequently requires rapid transit, or a low rate if it is of small value and not liable to damage by a long transit time. The passenger, however, has the power to classify himself or herself; some people prefer to travel first class in comfort, and to cut two days off their holidays; others travel third and cut one day off; still others travel by excursion train and can thereby afford to spend their whole holiday away. In Great Britain we have two classes, first and third; the intervening second class appears to prefer one extreme or the other, and only shows itself spasmodically in suburban areas or on boat trains. In America and Canada there are two classes, namely, ordinary and Pullman; in Germany one has a choice of four classes, but rarely more than two or three on each train; in France and Belgium there are three classes. The passenger in all countries is permitted to choose, within reason, between the accommodation provided on the train he intends to travel by.

With freight it is entirely different; although Company's risk and owner's risk make alterations in the charges paid, each kind of freight is placed within its classification; under the new classification which came into force on the "appointed day" there are no less than twenty-one classes. What is the effect on freight-train service? It is not often realized that the British freight-train problem stands quite by itself in the world, the reason for this being threefold. One cause has always operated, namely the short length of the average haul, due to geographical considerations and to a dense population. The second is the fact that, as the greatest maritime trading nation in the world, Great Britain is the centre of the world's entrepôt trade. We import wheat, wool, cotton, pig iron, tea, rubber, and even furs are imported from Canada to be dressed and re-exported across the

Atlantic. The third reason has partially arisen from the first and the second, and may be said to be, in short, the problem of road competition. It has arisen entirely within the last twenty years. Our roads are the best in the world, which makes road haulage cheap, though this is offset to a certain extent by the comparatively high price of petrol, which must be imported at present, since no commercial success has been achieved by distillation from coal as yet. With an average haul for all types of traffic of 55 miles in a normal year, it may be said that there is no passenger or freight traffic which could not be handled by road, though in practice for bulky articles like coal or bricks, rail transport is much cheaper and for passenger traffic of over 50 miles it is usually faster.

The characteristics of British freight-train service then must be frequency, speed, comparatively low cost, and punctual working. The foreign system of one freight service a day is not suitable for British practice, and, though our wagons are too small for cheap operation, it is difficult to foresee the time when anything more than a 15-ton standard is likely to be considered a commercial proposition, though 20 tons is a better standard for mineral and quarry traffic and special high capacity wagons may be used with advantage on certain set routes in connection with certain regular traffics. With the gradual growth of trade in foreign countries it is likely that their freight-train service will, so far as speed and time-table working are concerned, more closely approximate our own. To-day, however, in America and Canada it is the normal practice to work freight trains on many lines, not according to set time-table working, but as the traffic offers. This results mainly from two reasons: the much greater seasonal nature of the traffic, and the despatching, or "meet" system, where a despatcher sits in a central office and transmits written orders by telephone, though it used to be by telegraph, to the train crews. Such a system was essential on single-line tracks with an infrequent service, very heavy trains, and practically no signalling equipment.

Although a few lines, like the Pennsylvania, with its many miles of four tracks, and the Chicago, Burlington and Quincy, now work all passenger trains under the block signal, the old despatcher system still survives, the latter acting in some respects as our controllers, but there is little close resemblance between the control system and the American despatching system to which it claims the relationship of first cousin.

British freight trains work to a time-table in the same way as passenger trains, except that the details of the latter are exposed to the critical eyes of the public, while the former are not, and are only criticized by the actual sufferers in the form of the traders who always expect a very high quality of service. To them nowadays service is quite as, if not more, important than rates charged. The greater the percentage of freight trains which appear in a working time-book the better, and they should be included in the same book as the passenger trains. The ideal to aim at is to have a working, or "path," for each train which is to be run. This is not always feasible when a special seasonal traffic like beet has to be carried, or import traffic depending on ship arrivals, especially where this is perishable, such as meat from Liverpool to London which depends upon steamship unloading and dock clearances, or for fish from Aberdeen depending on tides and weather at sea.

It is the normal practice on most railways abroad to give each path or working a number, odd for up, and even for down, and very often trains become known by their numbers. Any tendency towards the naming of passenger or freight trains is desirable, especially the adoption of the names by which they are known to the staff; the very fact that trains are named by the staff shows the need for such a practice. To be able to give a path to each train it is essential to have worked out a fair number of spare paths, some at passenger-train speeds, some at fast-goods-train speeds, others at slow-goods or mineral-trains speed. In most foreign countries there are two classes of freight trains, the fast and the slow, higher charges being made for the former, which are

usually fitted with automatic brakes. In France they are known as Grande Vitesse and Petite Vitesse, while in Canada and America the fast trains are known as "Red Ball" or "Manifest" freight trains, and their running is as carefully watched as that of passenger trains.

This subject cannot be left without mentioning brakes. The coming of the automatic air-brake, whether Westinghouse or vacuum, was the means of adding considerably to the safety of the passenger train, and raises the question of adoption of similar brakes for freight trains. Such brakes have for years been fitted on the other side of the Atlantic; Germany is standardizing on the Kunz-Knorr brake, a variation of the Westinghouse, which France is now adopting. Other countries are discussing it; can we do the same and is it desirable? There are two factors which detract from the wisdom of a similar policy in this country. These are the number of privately-owned wagons, which would make a railway policy of this kind utterly useless unless they were similarly equipped; and, secondly, the short-haul nature of British freight traffic. Leaving aside all question of expense which is important, in the case of Germany it cost about £20 to equip a wagon with the Kunz-Knorr brake, the delay in marshalling yard operation and at other sidings would make appalling chaos. The lack of reception lines at British marshalling yards provides a serious difficulty, for with automatic brakes the train must be allowed to stand for some time before the wagons may be pushed over the hump or down the gravity sidings. From American experience it is doubtful if greater safety would be obtained, as the adoption of air-brakes means a coupler getting between each wagon, as does also the adoption of the screw coupling universally used on the Continental freight trains.

Although the British railways do not make higher charges for the use of fast freight trains, the various types of trains are run at different speeds. The pick-up, or wayside goods, or freight train has probably the lowest overall speed, because it may be required to shunt for thirty or forty-five minutes at the various stations it

serves. With a somewhat higher overall speed is the heavy mineral train, weighing up to 1,500 tons, but its time is slow, not because of its shunting work, but because of its weight. For that reason it is highly to be desired that such a train be kept moving once it has started, except for the stops made for locomotive purposes. In such cases the cost of starting the train is heavy in fuel, and has recently been placed at about 5*s*. 6*d*.; also in stopping it there is considerable brake wear, which is all the more true where freight trains, as in this country, are not fitted with automatic brakes. Next in higher speed comes the through freight train carrying as a rule a proportion of freight which is more urgently required than mineral traffic. Higher still are the speeds of fast freight trains which are often carrying perishable traffic, the arrival to time of which is extremely important to a Company's prestige.

High speed and heavy tonnage tend to offset one another, but there is a happy medium when one is moving the maximum number of gross ton-miles per train-hour. Thus, for a train of 400 tons travelling 20 miles in the hour we get a gross ton-mile per train-hour figure of 8,000; with a 1,500-ton mineral train travelling 12 miles in the hour we get a corresponding figure of 18,000 gross ton-miles. Assuming that the costs of running the trains be the same, which is unlikely, but they may not be very different, it is clear that the work earning a revenue will be far higher in the second case. But it is not quite so simple as that. Supposing that the 1,500-ton train was composed of 100 mineral wagons—the Great Western Railway runs these 100-wagon trains on certain sections of its line—and the 400-ton train was composed of forty wagons loaded with lighter freight averaging 4 tons per wagon and an average tare weight of 6 tons; what is the operating problem involved in the comparative weights of these two trains?

Firstly, the locomotive will have a greater adhesion, and a smaller diameter wheel, with consequent increase of tractive effort in the case of the mineral train. The time required to pull out of a yard or siding will be

greater, its normal speed will be lowered, although this to a certain extent will depend on braking power. The length of the mineral train will make any shunting into refuge sidings impossible, and therefore only loops can be used to permit a faster train to pass it. The question of loops is itself a difficult one, as there are few loops on British railways that will take a 100-wagon train. The problem of a gradient is another serious factor against the very heavy mineral train. The 1,500-ton train may be suitable for a stretch of track with no gradient exceeding 1 in 500 ; but if it comes to a stretch of 1 in 150 or 1 in 100, it will either have to be banked or cut in two and reformed at the far end. If the lay-out at the bottom of the bank makes this cutting of a big train into two parts very costly or difficult, or if the traffic is dense at that point and mineral trains cannot be permitted to wait to attach a banker or pilot, it may be desirable to run two 750-ton trains for the whole length of the level track as well as up the bank. If the overall speed in this case was 15 miles per hour, one obtains a figure of 11,250 gross ton-miles per train-hour.

The coming of the eight-hour day also considerably affected this problem in two ways. Firstly, the time for delivery and receipt of freight at a station is considerably shortened, thereby increasing the degree of congestion at the station and limiting the period during which wagons may be dealt with and the time at which they must be placed at the disposal of the trader. Secondly, the eight-hour day limits very considerably the distance travelled by train crews if the payment of overtime is to be avoided.

The natural desire, then, is to increase the speed of the freight train by every means possible, so as to enable it to reach its original destination, and then after turning round, for the train crew to return to their home station. This is not easily achieved. Fig. 23 shows a ten-hour and eight-hour shift ; in both cases thirty-five minutes is allowed for preparation time and twenty-five minutes for finishing time. To attempt the latter the turn round has been cut as fine as possible, but if this is overdone

the engine will often be working badly on its return journey for lack of clean fires and attention, especially if it was delayed on the outward journey. The margin of delays is liable to be cut too fine, and, as every railwayman knows, and knows to his cost, delays are, to say the least of it, cumulative. To increase the speed of the average freight train there are certain methods which may be adopted: one may increase the power of the locomotive, reduce the weight of the train, add improved signalling devices so as to improve running, or increase braking power where possible, in which case the ideal is the complete automatic brake system.

It is a matter for surprise to many of those who watch closely the operation of British railways that the average train-load in net tons, which is really the tonnage of

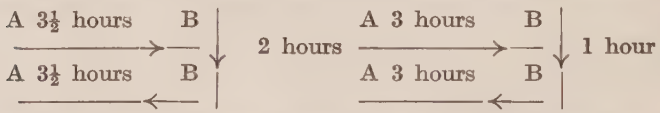

Fig. 23.—Diagram showing effect of 8-hours day on locomotive working.

freight-paying revenue, has actually decreased in recent years from about 140 tons to 125 tons.[1] This reduction is probably due to many causes; while possibly increased locomotive power has not been keeping pace with the greater speed which has become essential as the result of the eight-hour day, there is an increased density of the traffic as measured by the number of trains. The comparative prosperity of industry in the south of England to that in the north, as borne witness to by the unemployment returns, is important, for great stretches of mileage in one part of the country are not being worked to capacity whilst those in other sections are being worked above capacity, which necessarily slows up freight movement. There is also the increased frequency of service due to road competition.

In the case of main lines the great difficulty has been that of axle loads on bridges, to better which heavy

[1] 1926, an exceptional year.

capital expenditure is necessary. Unpunctuality finally as a result of poor foreign coal during 1926 became such a problem that double-heading of the most important expresses had to be resorted to in certain cases. Expensive though such a policy of double-heading of trains may be, it is very considerably cheaper over a short period of time than the rebuilding of many bridges or the construction of more powerful classes of express engines. The Midland Railway adopted such a policy many years ago in a wholesale manner, both for mineral and passenger trains, primarily to increase the speed without reducing the load. It is, however, noteworthy that in nearly every case the policy of double-heading has been assiduously avoided.

On a railway where the number of trains is high per mile of track, it is naturally desirable to increase the weight and speed of trains even if it requires double-heading to ensure punctuality rather than to run more trains, because with the latter system more train paths somehow must be designed, and with the comparatively little capital expenditure made by our railways during the war period and scarcely as yet made good, many lines are at present working at full capacity. Good service to-day is more important than cost, for trading becomes of a more retail nature each day, especially where prices are fluctuating, for no one wants to hold stocks if that can be avoided. Five years ago that kind of loss was much more common than it is to-day. In the United States the Ford Motor Company, because of transportation conditions, found it necessary to assemble the raw materials from sixty to ninety days ahead of daily needs of its factory. To-day this Company is reported to be operating on a five days' supply, only made possible because the reduction of time through better railway service has been one of the business achievements of the past five years. Reducing waste, coming and going, has reacted for the benefit of every one, and has especially affected production and merchandising methods.

Reliable, frequent, and punctual service is thus essential

for the success of a British railway, for the trader to-day will otherwise order a lorry-load to keep his stock up to date. The retail nature of trade has assisted the smaller unit, namely, the lorry—to the disadvantage of the bigger unit—the railway wagon. Unpunctual service not only causes loss to the trader, it causes loss to the railway in many ways, some of which can be calculated in terms of money, but many of which cannot. Amongst those which can be reckoned are payments for overtime, extra fuel, water, lighting and heating. Amongst those which cannot be reckoned are the bad effect on the morale of the staff. But there is a heavy added cost to the railway itself: the unpunctuality of one train causes delay to many others and congestion is likely to follow. Any delay reduces the availability of the locomotives, train crews, carriages, and wagons. It is useless to roster a freight train guard for a train at 7 p.m. if he has not yet returned from the trip he started on the previous day at 7 a.m. The total loss to the railway is incalculable in money, but is very serious; the whole work is gradually slowed down in a time of congestion, and it may take days to get back to normal schedules again; it is better to put on an embargo for two days than to wait until a yard is so congested that an embargo has to be put on for ten days.

There is also the effect on the passenger or trader. An unpunctual line gets a bad name, and people travel by a rival line or by road. Similarly, a trader who had to wait ten days for his goods to travel 150 miles sends them by another route or by road. Freight-train service must be regular and punctual, and there is much truth in the old railway adaption that "if you look after the punctuality of the freight trains, the passenger trains will look after themselves," provided that it is not interpreted too literally. Speed and the train-load are the antitheses of one another, and the endeavour should be to get the maximum number of ton-miles per train-hour, paying at the same time due respect to the geographical and physical characteristics of the line and density of traffic, and at the same time paying due regard

to ratio of expenses of operation to the revenue derived therefrom, namely the figure known as the operating ratio.

Like all train-working problems the general principle is that of the round trip. It is little use for a controller or yardmaster to cancel a train when he has only twenty wagons, if he does so regardless of the balanced working, or return journey. Sufficient traffic may not present itself at the original starting-point, but it is then the duty of the controller or yardmaster to see whether he cannot pick up a further twenty wagons or so, at the first or second point on the train's route, for there may be a full train-load for the return journey. The ideal to be aimed at is the maximum ton-miles per train-hour for the whole round trip ; thus on the outward journey it may be better to run a fairly light train for part of the distance and pick up a full load at a half-way point rather than to run a half-loaded train on the whole outward journey. Let us take a concrete example of a 60-mile run. If we run twenty-five wagons, say 250 tons, for 30 miles in two hours and then add another twenty-five wagons, or 250 tons, making a full load, we get for the first part of the journey a gross ton-mile figure of $250 \times 30 = 7{,}500$ in two hours ; add to that the second part of the journey, which, let us say, takes three hours, that is, $500 \times 30 = 15{,}000$ in three hours, giving a total of 22,500 in five hours, which is 4,500 gross ton-miles per train hour. Comparing that with running a train of thirty-five wagons, or 350 tons, right through the 60 miles in five hours one obtains a figure of $350 \times 60 = 21{,}000$ gross ton-miles in five hours, which is 4,200 gross ton-miles per train-hour.

Unfortunately there are few figures available concerning the cost of delays to a train on English railways, but recently much work has been done by the Interstate Commerce Commission in America, and the resulting figures are very illuminating. The total cost of running a freight train at 11·1 miles per train-hour and 12·5 miles per hour was compared. Per freight train-hour the costs were, including car repairs, approximately £5 9*s*. 7*d*.

and approximately £5 12*s*. 7*d*. On a trip of 125 miles it was reckoned that a delay of seventy-five minutes cost £5 5*s*. 6*d*. Our costs here are probably much lower than this, as the average weight of our trains is only about 135 net tons compared with (in 1926) 750 net tons in America, but the reduction in costs would not be proportional. In America a ten-coach passenger train is estimated to cost 5*s*. 7*d*. per mile to run, and the additional cost of running an extra coach 300 miles has been estimated to be only 3*d*. per mile.

The difficulty of scheduling train crews for exact eight-hour shifts is self-evident, and it is all the more difficult if due consideration is given to meal-times included within the eight hours. The situation is more complicated with freight trains than with passenger trains, as the former are more liable to service delays and they do not work with such regularity as passenger trains. Special attention must therefore be given to freight locomotive rostering, so as to eliminate overtime as far as possible. Certain drivers and firemen prefer overtime, as it adds to their pay considerably; but the practice is not desirable even from their own point of view, as it entails a degree of overwork and fatigue which may lead to over-running of signals and consequent danger.

From the railway's point of view overtime is highly undesirable, as the rates of pay for work done are on so high a level. As a result of the eight-hour day policy it has come about that one locomotive per crew, however desirable it may be, cannot even be arranged for express passenger locomotives, much less for freight trains, although there are distinct signs of a return to that policy by many foreign administrations, it being claimed—and their figures are conclusive evidence that they are right—that the greater degree of punctuality obtained, reduced maintenance cost, and better morale of the engine crews offset the increased first cost of locomotives.

It is, however, normal in this country to-day for a crew to change engines, so that although the engine works through the crew does not. This may be arranged

on the crew rosters and engine workings, or it may be effected if trains are running late by a controller, and from observations of various control offices it might be said that this is one of the main functions of the control office, though probably few controllers would admit it. The control system will be mentioned in detail in a later chapter. With present practice brake-vans also cannot be looked upon as the individual property of the goods guard for the same reason, with the result that, like the engines, they are not kept up so well, and it is difficult to keep them supplied with the requisite quota of tools.

During the discussion of passenger-train working no mention was made of the guard's journal, for the reason that it is even more important in the case of the freight train and may be mentioned with advantage here. In the case of the passenger train the guard's journal shows the train, date, type, and number of locomotive, name of the driver and his shed, number and type of each coach, tare weight of each, where passenger train vehicles have been picked up or dropped, time of departure and arrival, and main passing points. The passing points chosen are not necessarily stations, but may be signal-boxes, at the bottom or top of a heavy bank like Brentwood, Shap, or Leagrave, or they may even be mile-posts, but these latter are very difficult to pick up at night. Distances are also recorded, and particulars of all delays, time lost or gained, and the causes thereof. The passenger train guard's journal is usually made out in triplicate, two copies going to the district or divisional superintendent, the other going to the statistical department. On many railways the guard also makes out the driver's statement.

It will be seen that the guard's journal is one of the most important statements in use on a railway, for it forms the best record of the actual train operation and from it may be compiled the train miles, the gross and tare ton-miles for passenger trains. In the case of passenger trains the gross and tare tonnage is not very different, the maximum variation being only about 10 per cent., and that only occurs in the case of suburban

passenger trains with the trains crowded at crush periods. The mileage as recorded on the guard's journal is also used on many lines for finding the mileage run by locomotives, it being considered undesirable to have the locomotive crews making up these figures. Such a system, however, does not permit a check to be made on the guard's statement.

Turning to the guard's journal of the freight train, much that has been said concerning the passenger-train journal also applies to the goods guard's journal, but the latter is not so simple to compile. It is comparatively easy taking the tare weights of a passenger train on a well-lighted platform, but it is a very different matter taking tare weights, much less gross weights of individual wagons in an inadequately lighted marshalling yard. The difficulties have in practice been found to be so great that it is normal British practice to record the numbers of wagons only. It is true that the main difficulties are circumvented by this method, but it results in many features which are very disadvantageous to railway operating efficiency. To-day wagons vary from 6 tons capacity to 20 tons, while the tare weights would vary from 5 tons to 10 tons. Various schemes are in existence for correcting the tendencies to error caused by the unscientific method, such as recognizing a mineral wagon as carrying its plated capacity and taking a wagon loaded with merchandise as equal to 5 tons, or whatever figure may be decided upon. Often this system of averaging is more complicated than the tonnage system itself and has none of the latter's advantages. The argument against the tonnage system is that the British goods guard cannot or will not add up the figures correctly. Such an argument is in reality a libel, for if the French goods guard can do so, there can be no reason why the British goods guard cannot; in practice he is hardly ever given the chance.

In England hardly any wagon is marked with the weight of its load on its label, so that there is no chance of the guard being able to find what it is. Every foreign country adopts a label system which gives this weight,

though in Germany this is not always used for the load rating of the train, which is limited to so many axles, but in Germany wagons are standardized to a far greater extent than they are here. The evil results of our wagon method of train-load rating are that the driver cannot know what load he has behind the tender, the only clue he has is the proportion of wagons loaded to empty, and, of course, the total number he has on his train. Such a system is very unfair on the engine crew and the guard, who is to a certain extent responsible for the braking. But it makes other difficulties ; it is impossible for the railway to know to-day what tonnage they are handling, even our net ton-miles are obtained by a roundabout system of averages, which detracts from their utility for any accurate statistical comparison.

How can any improvements be effected in the efficiency of freight-train service if one does not know how great is the number of gross ton-miles ? For the gross ton-mile is naturally the unit of expense, it is what the engine has to haul and that really is the measure of the work it has to do. The whole problem comes down to the design of a better label, which should give the weight of the freight in the wagon. One would hardly look upon it as an impossible problem for solution, although the lack of wagon scales at small British wayside stations is admittedly a difficulty. As with passenger trains the goods guard's journal is the basis of many statistics both as to the running, punctuality, and work done in the form of wagons moved, for example wagon-miles from which the net ton-mile figure is actually obtained.

An important phase of freight-train operation is that of traffic to and from the ports. The London and North Eastern and the Great Western Railways are two of the largest dock-owners in the country, if not in the world, and, in addition, serve many ports, such as London, Liverpool, and Newcastle, where although not owning the docks, freight services depend largely upon the arrival and departure of ships. Traffic working in such cases must necessarily be of a very intricate nature, the more especially so when the docks are not owned by the

Company. It is the custom in most ports of this country, that, owing to the big variations in water level caused by tides, the ships enter docks where the goods are discharged partly direct into wagon or road vehicle, but mainly into warehouse or cold storage. It thus comes about that bulk trains of grain, wool, or cotton are exceptional in this country, although such cases do occur, mainly in connection with perishable traffic, such as meat and bananas.

At certain ports such as Southampton, which does not deal with a great bulk of heavy traffic, ships are unloaded and loaded without entering docks, but this is only possible because Southampton for all practical purposes has four tides a day. In the Thames ships are largely off-loaded in the river on to lighters and barges, with the result that the bulk cargoes are quickly distributed over many miles of river front, from Brentford and Greenford, where Lyons have their factories, down to Tilbury and Gravesend. The dock-owner must, therefore, normally in England be also the warehouse owner, and this is usually found to be the case; the London and North Eastern Railway has, for instance, extensive wool warehouses at Hull, whilst at Bradford are complementary wool warehouses for storage at the receiving end.

Great attention must be paid to this import and export rail traffic, as the country's prosperity depends upon it. If the sailing of a ship is missed through railway delays, contracts may not be completed in the time agreed upon and there is general loss to all concerned. Special fast working may be necessary for port traffic, and in view of its irregular character great care should be taken to see that there are sufficient free paths available for an added rush of traffic of this type.

Another feature of this traffic is the careful choice and normal availability of wagons of the right design, so that a ship can be discharged rapidly. It is difficult to load covered wagons with cranes, though such difficulty does not warrant the design of box wagon with opening roof that certain pre-grouped Companies adopted to the

despair and horror of their neighbours. Such wagons are hardly ever water-tight, and are very unsuitable for most forms of traffic. One of the main essentials with regard to dock traffic is the presence of a well-designed marshalling yard, preferably of the gravity type, for the reception and distribution of empties and loads to the various docks and sidings. This brings us to the consideration of marshalling yards, their function, and operation, which is discussed in the following chapter.

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CHAPTER X

TRAFFIC CONTROL AND MARSHALLING YARDS

For many years the American railroads have employed the despatching method as a means of regulating their traffic. In essence this system consists in conveying written orders to the train crews in accordance with orders from some central office, in place of the method for many years adopted in Great Britain of working trains according to the time-table and regulating their movements by means of signal indications. The American chief despatcher from his despatching office issues train orders by telegraph, nowadays more often by telephone, to stations and passing points where they are received and passed on to the train crews in the form of train orders ; it may be instructing No. 15 to meet opposing train No. 16 at Swift River or some other loop, or instructing extra freight No. 101 to wait at Greenmeadow until 7·57 before proceeding to Thomsonville. Such a system eliminated the need for fixed signals and centralized the control of train movements in the hands of a comparatively few highly trained and highly paid men who were enabled to visualize as a whole the traffic in their respective stretches of line. To-day this despatching system is slowly but steadily giving way to the control of train movements by means of automatic fixed signals often of the colour-light type, thereby eliminating the train order and replacing it by a system of the time-table type with movements controlled either by fixed signals, or possibly in connection with the use of automatic train control. Whatever may have been the original connection between the American despatching system and the traffic-control system as introduced by the late Midland Railway in 1909 primarily for mineral train control, to-day, as deve-

loped in each country, they are wide apart, although signs are not wanting that present American tendencies may lead to a closer approximation to the British system in future years. Their main connection at present, however, lies in the fact that both rely upon centralized control. The need for a centralized control of traffic in Great Britain hinges upon the undoubted need for making the most of existing track facilities and the best use of existing lay-outs.

The adoption of such a system by the Midland led to a remarkable reduction of overtime paid to train crews and at the same time to a decided betterment in the degree of punctuality of the passenger and freight train arrival times. There is much sense in the motto that if the movements of freight trains are carefully watched and regulated the passenger trains will take care of themselves, and far too much attention was often granted in the past to passenger-train operation regardless of the delays thereby caused to freight-train operation, with the resultant heavy toll in added costs.

The success of the original Midland system, which originated between Cudworth and Toton in January, 1909, and was based on the good results of the work done at a relief office opened at Masboro' in 1907, became rapidly visible, with the result that in due course the whole Midland system of over 1,500 route miles was divided into twenty-six areas, the size of each depending mainly upon the traffic density. Each area possessed a district control office which was placed in direct telephone communication with all signal and siding boxes and stations in the territory concerned, and surmounted upon which was a central control office at Derby, whose work was to co-ordinate that of the district controls, adequate trunk telephone lines being installed. As a consequence of allotting all regular trains set schedules or paths and leaving additional paths free for specials, the main task of the controls was to watch and direct the movements of trains, so that, as far as possible, adherence was kept to these paths.

In six years the weekly average delay in hours had

been reduced from 21,869 in 1907 to 7,749 in 1913, the latter a year during which over 50,000,000 tons were carried, an important increase over the tonnage handled in 1907. This centralization method brought all train movements directly under the supervision of the General Superintendent, who was also responsible for the control of locomotives and rolling stock, an organization which must be carefully arranged so as to be adaptable to the changed circumstances resulting from alterations of personnel at the head with different qualifications of training and experience. The post of General Superintendent corresponds closely to the American title Vice-President in charge of Transportation. In America, unlike in this country, the majority of operating officers are trained as engineers, though in England the appointment of an assistant who takes the title of Motive Power Superintendent overcomes this difficulty (*vide* Chapter II, p. 24).

There can be no question that such an organization co-ordinates in the best possible manner the work of the Operating and Running Departments as well as covering a large part of the work done under other organizations by the Passenger Department. Whatever may be the organization problem at the top caused by the adoption of a centralized control system, there are equally important organization problems involved at the other end, both in the district controls and in the signal-cabins. Increased centralization must result in decreased power of initiative elsewhere, and the degree to which centralization should be carried is limited to the point at which the benefits of the wide outlook of the control staff are offset by the lack of interest and loss of initiative which must result in the case of station and outside staffs. The real problem of control lies in the difficulty of finding this point. It is primarily a question of the choice of personnel; for the controller must be tactful and *au fait* with the outside work of the section he is to control, before he can hope to be more useful than disadvantageous to the interests of his Company. Every railwayman has heard stories of Controller A who ordered an engine to

Whippenset when he meant Pithersett, of Controller B who ordered a signalman to put a train into a siding at a station where no siding or even a crossover existed. All such faults are put down to the adoption of the control system ; in fact, they are entirely errors in choice of personnel or lack of care on the part of higher officers to afford adequate training facilities.

Expert opinion seems still quite divided as to the desirability of the wholesale adoption of the control system ; the clue to this somewhat surprising state of affairs in view of its unquestioned success on the Midland Railway, and more recently over the much greater L.M.S.R., would appear to be the total diversity of conditions existing on the different British railways, and even between various areas of the same railway. The same reason accounts for similar divergences in other realms of railway operation and management.

The Lancashire and Yorkshire Railway, also now part of the L.M.S.R., possessed an important traffic control system based upon a control office at Manchester, which began to control freight traffic in 1915. Intended at first to be mainly local in character, it inevitably spread its tentacles to Liverpool, where much of the traffic either originates or terminates at the ship's side, and to Goole where, to a smaller extent, the same conditions applied. The London and North Western Railway was also experimenting with the control system prior to the grouping, but it cannot be said to have standardized upon any definite scheme covering wide traffic areas. Since the formation of the L.M.S. group the control system has been extended to other large sections of the mileage both on the late London and North Western and the Caledonian Railways.

On the eastern side of Great Britain the London and North Eastern Railway has never adopted the control system in its all-embracing nature. In the North-Eastern Area Middlesbrough quite early possessed a control office to organize the trip-engine workings leading down the trains of ore and coal to the Newport and Erimus marshalling yards. In later years Newcastle was forced

to adopt a district control office to regulate the work of the shunting engines and local traffic in and out of the complicated maze of lines centring upon Newcastle Central passenger station. A control office at Hull regulated the traffic mainly originating from the South Yorkshire coalfield to the docks at Hull, whilst recently a main-line control office was set up at York to control the operation of the main-line passenger and freight trains between Shaftholme Junction, the southern limit of the North-Eastern Area main line, and Newcastle. It will be seen that, with the exception of the last named, each of these controls is purely local in nature, designed primarily to make the maximum use of intricate stretches of tracks within congested areas, and to avoid unnecessarily blocking main lines with shunting and trip-engine movements which can be avoided by rearrangement.

In the Southern Area of the L.N.E.R. district controls have, for some years, been established at Nottingham and Leeds, whilst a similar type of office was working at Doncaster on the old Great Northern section. Each of these possessed special telephonic facilities, and more recently similar district offices have been opened at Sheffield and Manchester. On the old Great Eastern section was a headquarters control at Liverpool Street, which also dealt with the dense suburban traffic working to and from that station, and connected with outlying controls at Cambridge, March, and Ipswich, but these latter were more accurately train-reporting stations and possessed no adequate telephone facilities for dealing with the essentials of traffic control work. Great improvements have recently been made at Cambridge with the adoption of an up-to-date district control office acting under the close supervision of the district operating superintendent, whilst at King's Cross in 1927 was put into service an extremely well-equipped control office for regulating freight traffic on the old Great Northern main line. Placed within the office of the District Operating Superintendent, this latest organization is noteworthy for the extreme care with which the personnel were chosen, and the great attention to important details in the office.

In the Southern Scottish Area of the same Company existed the three control offices set up by the old North British Railway at Edinburgh, Coatbridge, and Burntisland, the latter paying special attention to the coal traffic for shipment, which is handled at that port, but also regulating traffic on the main lines and keeping in close touch with the sister offices at Edinburgh (East) and Coatbridge (West). A feature of the Burntisland control office is the preparation of a daily punctuality return, which demonstrates the excellent use of the control system for the preparation of returns of this nature, whilst nearly all control offices are equipped with controllers whose entire duty consists in arranging reliefs for locomotive crews and guards, and the prevention of long turns on duty and the elimination of overtime payments. A notable example of this feature is the work done at the new King's Cross control.

From this brief outline it will be seen that the L.M.S.R. and L.N.E.R. systems of control are totally different, the first possessing a centralized headquarters and the second consisting merely of a series of district control offices. In certain areas of high traffic density the G.W.R. has also adopted the control system.

Differences of opinion exist as to the desirability of furnishing the controllers with a geographical board showing the lay-out of the tracks ; the length of refuge sidings, and loops ; and the provision of water cranes and so forth : where such boards exist they are equipped with holes so that the position of trains may be marked upon them by means of variously coloured pegs whose heads bear numbers. An alternative is the plain time-board as favoured by the L.M.S.R. ; ruled like a graph, this type of board shows the stations vertically from top to bottom and the time intervals, usually every five minutes throughout the day, divide up the horizontal width with sufficient space to carry the spare tickets for locomotives temporarily out of the district at the extreme left or right. Each square contains a peg upon which may be hung the tickets showing the positions of trains, engines, and crews. The use of such a board assumes that the controller

possesses complete knowledge of the track lay-out and all physical features in the section for which he is responsible. Such an assumption is somewhat dangerous, and beyond the first cost a geographical control board costs practically no maintenance, but it also possesses a danger in that, if difficult to reach, the controller, who is usually working at high pressure, omits the pegging of his trains. Whilst possibly pegging is not essential, it is concrete evidence to the chief controller and does serve to remind the controller of train positions, for instance, in sidings awaiting a suitable opportunity to enter the main line ; for this reason alone it should be carried out. In the past doubtless far too much insistence has been placed upon the complicated design of board employed, and often this was regarded as a show toy to impress visitors, rather than as an assistance to the work in hand.

The diagram automatically lighted by the train is probably the ideal control office board, such as one finds in the latest designs of signal-boxes, as at Laon (Nord), or on the Underground electric railways of London, but it will be many years before this system can be in universal employment. In the meanwhile lights manually operated by buttons with three or four alternative colours would appear to be the nearest approach to the ideal commensurate with cost ; although the peg system would be less costly and more elastic, it necessitates continual movement and distraction from the main work.

If control offices are to be really successful and repay their costs of instalment, which is quite heavy in view of the extra telephonic communication normally required under British conditions, they should control all the trains operating over the sections. To inaugurate a control of freight trains over a section of line also carrying passenger traffic, is to invite friction between the control office and signalmen and station staff. One cannot assume that passenger trains always run to schedule, in fact they do not, and if their movements have to be reported to the control so that the latter may design the freight-train movement, they should also control and keep in touch with the passenger-train movement upon

which their work is so largely dependent. Claims are sometimes made that the very fact of a control system being in existence results in a tightening up of efficiency at outlying points ; to a certain extent this is probably correct, but it is also true that with a control system there is a tendency for a local employee to cease to trouble, since control takes the blame as well as the credit.

In addition to the regulation of trainmen's hours, the control of scheduled trains, and the finding of paths for specials, a control may also prove most useful as a means of easing the difficulty of congested yards, and even up to a certain extent the demands for locomotive power between several depôts. If accurate train records are kept, a close watch can be kept upon punctuality by this means, and the excellent telephonic communication enables the control office to be a link in the collection of the estimated empty wagon demand figures for the following day's working, a question which now merits close attention. Balances of common-user wagons between Companies are arranged by the Railway Clearing House at home, and in France by the Office Central du Mouvement des Wagons.

The problem of freight rolling stock supply is one of the most important of all operating problems, because any failure in this respect is immediately felt by the trader and the country's industries. The main objective to be aimed at is an adequate supply of wagons at all stations as required, but against this must be placed the railway's desire to keep its number of wagons at the minimum. From this it follows that the more rapid the velocity of wagon movement the fewer wagons will be required, the lower the capital sum sunk in freight rolling stock and the less the annual depreciation charges.

How is this maximum velocity to be obtained ? Good operating methods and marshalling yard design assist it as well as efficient motive power operation with reserve for unseen eventualities, together with rapid unloading and loading. But given all these much must depend upon the organization by which a surplus of empty wagons at any one station may be used to the maximum advan-

tage, and there are many varied systems in use to achieve this end. The old-fashioned method was to report a surplus by letter to the chief goods manager and to ask for instructions, which is too slow and cumbersome to-day. On some railways there are standing orders to send all empties surplus to requirements to certain concentration points, box-wagons to J, from stations A to H; open high-siders to K, and flats to L. Such a system is better than that already mentioned, but does not make any allowance for unexpected traffic movements, as, for instance, the arrival of a boat with wool at a port. A third method is to report by wire the position so far as it can be foreseen at every station during the afternoon, giving the probable requirements of the next day's loading. The most usual method in use to-day is a combination of these two systems; namely, what one might term the automatic-flow system and the wagon-control system. The automatic-flow system is designed as a result of years of statistical study, and is based on the knowledge that certain stations always "make" empties, while others always require empties. If one takes an individual station, one may find it to be in one of these classes; but taking the district as a whole, of which it is the centre, it is quite possible that the district may be self-supporting, that is, makes on an average as many as it requires, while most of the port districts require wagons. This will be self-evident if one remembers that Great Britain is primarily an importer of goods rather than an exporter, and the imports are mainly bulk materials which require many wagons, while the exports are mainly manufactured articles which, generally speaking, take up less room. Thus, Liverpool, Bristol, London, and Hull, normally require to be fed, if one excludes coal, because this is primarily carried in privately owned or specially designed wagons which automatically return empty to the coal-fields. On the G.W. system twelve empty wagon stock trains run every day,[1] if required, from wagon-making districts to wagon-requiring districts.

[1] "Wagons and their Ways," H. W. Payne. G.W.R. Lecture and Debating Society, 1927.

The wagon-control system was brought into use to co-ordinate activities and to act as a means by which sudden wagon demands might be met. Undoubtedly the wagon supply and requirements must be controlled at one place in each district, otherwise empty wagons going east may meet empty wagons going west, a great waste of haulage power, in addition to blocking up the tracks for other trains. But, on certain railways, this idea of district wagon control has been taken very much further. The district wagon supply and requirements are, therefore, passed on to some central office and there co-ordinated, so that each district in practice is equally well off for wagon supply. It would be difficult to say as to whether such control should be exercised by the operating or goods department, but possibly the latter ought to have the final judgment. In practice for every-day work it is, however, more usually carried out by the operating department through a wagon controller. The main problem to be decided is to what extent the regulation of empty-wagon movement should be centralized.

Traffic control is closely correlated with the problem of empty-wagon supply ; if the latter is efficiently organized the volume of traffic occasioned by empty-wagon running will be reduced to a minimum. In many respects, therefore, a traffic control provided with an excellent telephone service is an appropriate organization to undertake the distribution of empty wagons, and such is actually the case on the L.M.S.R. As in the case of the control system for traffic working, so the wagon-control system is primarily a problem of centralization against decentralization ; but it may well be that in the former case centralization is on the whole desirable, while in the latter it may be, on balance, undesirable. Control of movements may best be in the hands of those who possess a bird's-eye view of the line as a whole ; trains are either available for moving, or they do not exist ; empty wagon supply is a totally different question, for if wagons are available they may create traffic, whilst if they are not available the traffic may pass by other means. With

strong road competition personal touch is essential between the local railway officer and the traders, yet the former is without power to assist the latter if he is starved of empties to place for loading. Centralized wagon control certainly tends to reduce the wagon park of a railway, but unless organized with extreme care it does so at the risk of losing much traffic.

The essence of adequate service to the trader lies in permitting him as late a wagon demand as possible ; few traders to-day can foresee accurately their wagon demand for the following day before 4 p.m., which would permit a district officer ample time to make his distributions for the next day's working and to make up trains of empties for despatch during the night. With purely centralized control such a position is impossible, for the wagon demand under that system is being collected by individual stations about midday, is sent on to the district officers by 3 p.m., and is being received at the central control by 4 p.m.–4.30 p.m. Could any method be more calculated to annoy the trader and to induce inaccurate demands ? There inevitably appears in a central office a spirit of accusation against certain districts of efforts to inflate empty-wagon demands ; in practice no operating officer will ever want to hold more empties than he will require to use, for tracks in Great Britain are invariably too congested to make such a policy pay. Centralization often results in the grant of theoretical preferences to certain traffics, or orders empties to be made up into trains for despatch quite irrespective of whether the locomotive power is available. Not long since during a serious wagon shortage at Port A orders were given to form three trains of empty wagons for despatch to Port B, nearly 200 miles distant, to receive import traffic exactly similar to that contained in the ships at Port A adjacent to which the wagons were standing empty. The trains were drawn out, made up, and stood awaiting available locomotive power for three days, whilst a fleet of lorries off-loaded the ships at Port A. Such a position could not arise with decentralized wagon distribution and should not arise with a centralized system, but in

practice under the latter organization cases of this nature are very difficult to eliminate.

Among the advantages claimed for centralization are the following: a more even and fairer distribution of wagons for loading in the various districts; necessary work can be done with fewer wagons, thus obtaining important economies; it also yields a better wagon user or quicker round trip; the wagon position from day to day is shown at a glance; it compares the efficiency of various districts and aims at standardization, though there are certain dangers in this; and lastly, it enables a closer check on those yard-masters and station-masters who always over-estimate their wagon demands and under-estimate their wagons to be unloaded, though this probably originated from inadequate supplies of empties at an earlier period. Amongst the disadvantages of central wagon control are, firstly, that it necessitates an earlier estimate of wagon demands from each station, and, consequently, makes for inaccuracy of estimated demands; secondly, no central office can study local requirements as can a district office; thirdly, there is a tendency to keep cutting the wagon stock too low without regard to seasonal changes or emergencies; fourthly, under certain conditions it may actually create added empty haulage by lack of local knowledge; and, fifthly, there is too great a tendency in such an office to regard success entirely by figures. The cases where one reads that the wagon demand had been met exactly 100 per cent. most practical railwaymen will regard with scepticism.

The benefit of centralized or decentralized wagon control should be balanced in some way against the cost of using the system, in so far as that can be obtained. In fact, it is a very similar problem to that of the Control System, and one can only state one's opinion in both cases. One must choose between initiative and personal touch on the one side, against a broader viewpoint and co-ordination of activities on the other. The seriousness of road competition has altered the position completely, and necessitates the exercise of much local tact, assist-

ance, and initiative in connection with traders, and there is a danger that such initiative is liable to be killed by centralization.

In the case of Germany control of freight is very largely exercised at the marshalling yards with which the German Railway Company is very copiously supplied, and it would be hardly an exaggeration to state that the organization of the German freight-train service hinges upon a series of nodal points, namely its marshalling yards. Great Britain is not too well supplied with these yards for sorting and resorting freight trains, but their method of operation is worthy of the closest study because, like the Post Office sorting offices and letters, few loaded wagons in the course of their journey do not pass through one or more marshalling yards.

The marshalling, or classification, yard, as its name implies, fulfils for the wagons what the tranship, or transfer, station does for small consignments. The tendency will be to set up a marshalling yard at a point where many small streams of traffic meet, and to which, for example, the trip engines from the docks or various coal depôts all around a city may bring twenty, thirty, or even forty wagons, some loaded, some empty, and in the marshalling yard they will be in turn passed over a single track which supplies twenty or forty tracks, each of these being allotted to certain routes and destinations. By this means it is possible to make up trains to the maximum load rating and by careful choice of destination to arrange that all traffic for C may be made up into one train which is able to run through the next yard. If to obtain a full train-load for C entails too long a wait, it may be necessary to make up a train for B, and for B to reclassify the train and bring it up to a full load for C. It is the same principle as the tranship system which was described earlier in some detail.

There are three main types of marshalling yards: firstly, the flat yard; secondly, the hump yard; and thirdly, the gravity yard. The flat yard is an ordinary shunting yard with a shunting neck, and the classification of wagons is effected by drawing a rake of thirty wagons

out, and after uncoupling propelling the rake back and stopping short so that the wagon or wagons continue to move on to the desired line. In practice most of these shunting necks are inclined, so as to assist the movement of the wagon; but the capacity of such a system is distinctly limited, the wear and tear on brakes is very heavy, and for efficiency a locomotive with very high acceleration and braking power is necessary. As traffic has outgrown many of our original flat yards, a number of them have been converted for double-end working, which means a shunting neck at each end and two locomotives working at the same time, one at each end. In this case it is customary for the working at one end to consist in breaking up the trains after their arrival, while the other end marshals the wagons in the desired station order, after the wagons for any one train have been placed on a single track. Because of the necessity of keeping two roads free for transfer traffic from one end to the other and for other practical reasons, such double-ending does not, in practice, double the capacity of the average flat yard. In any marshalling yard the lay-out should make provision for the rapid clearance of train engines on arrival; for the careful placing of the brake van line; a line for cripples; and for miscellaneous traffic awaiting reconsignment, transhipment, and so forth. All reception lines should naturally be long enough to accept with ease the longest train likely to be used in the near future. The flat yard is distinctly limited in capacity, and after its capacity has been reached, a railway must adopt the hump or gravity method, though it appears that no minimum number of wagons to be sorted per twenty-four hours would warrant necessarily the conversion of a flat yard into a hump yard; cases have even occurred of conversion from a hump to a flat yard. In short, each yard is a problem in itself.

In the case of both the hump and gravity types the ideal to be aimed at is the series of three yards; namely, the reception sidings, the sorting sidings, and the departure sidings. Where geographical conditions permit, it is highly desirable to consolidate the two directions of

traffic flow so that the same set of reception, sorting, and departure sidings will serve for all traffic. This has been arranged very ingeniously at Lille (La Délivrance), on the Nord Railway of France, where the physical lay-out was favourable. This arrangement is also in use at Chaddesden, near Derby, L.M.S.R. Such a combination is highly desirable where there is an important percentage of traffic which arrives, let us say, from the south and requires to depart in the same direction, for if amalgamation of the yards cannot be arranged the work in both will be delayed through the fouling of shunting necks by trip engines crossing over with the transfer traffic.

Reception sidings should be designed with the following points in mind: adequate length and space between tracks, sufficient to ensure safety of working; good illumination, which is nowadays attained by electric flood lighting; the engine siding in a convenient position so as to eliminate fouling the points; and the number of sidings in relation to the needs of the individual situation. Gradients should receive special attention and depend upon the type of traffic using the yard, the running qualities of the wagons and the speed desired when each cut leaves the reception sidings. Simultaneous working of two hump tracks is also desirable if the destinations of the traffic enable this to be practicable. For sorting sidings one has to determine whether electric or manual point operation should be used, and whether to employ the older ladder design or to arrange the points in pairs. As with reception sidings the sorting sidings should be sufficiently long to eliminate the time normally wasted in pushing the wagons down so that the fouling points are cleared. Adequate lighting is essential to cut down pilferage, increase the degree of safety, and allow the work to be carried on as fast by night, or in fog, as by day; without doubt flood lighting best achieves this object. Gradient design is also a vital consideration. The accommodation required at a marshalling yard, and especially that part of it known as the sorting group of sidings, will depend upon the direction of the traffic and its volume and time of flow. It is also dependent upon

the length of trains to be hauled arriving and leaving; upon braking facilities; and upon the number of trains leaving during the peak period per day; as well as upon the capacity of other reception yards and the amount of traffic for reconsignment.

The main points to be watched with regard to departure sidings are their length, their number, the width between the tracks, the gradient, and a handy lay-out to permit brake vans to be dropped by gravity on to the ends of the trains. Provision must be made also for the rapid supply of lamps for trains, and facilities for locomotives to coal and take water before departure. Also the exit must be arranged so as to minimize the fouling of adjacent roads.

For many years the normal method of braking wagons descending humps, or from gravity reception sidings on the French and German railways, has been by means of a manually placed shoe, a system expensive in staff and wasteful, in that the shoes lasted a comparatively short time before being reshod. During the post-war period many attempts have been made to replace this manually operated shoe by a more efficient method, and in France the Deloison type of automatic shoe brake has been used with conspicuous success for many months at Lille (La Délivrance) and Blainville. Loss by damage and claims has been greatly reduced, and the staff also reduced in these two very modern yards where the speed of the wagons is very high.

In the United States marshalling yard operation is of a somewhat different type, because the normal system is for car-riders to descend from the hump on each cut of cars and slow them down by means of brakes operated from the roofs of the cars. In many cases the men return by means of an electric tram car to the base of the hump. This system has long been recognized as most dangerous, and as a consequence has attracted a low class of labour, while the labour turnover was much greater than in other grades of service. Consequently, as in Europe, much experimental work was done to find a better system, and in 1925 a car retarder or rail brake system whereby the wheels are squeezed by rails which press against the inner

flange was adopted by Mr. Hannauer on his Indiana Harbour Belt Line, a subsidiary of the New York Central, at the Gibson Yard, Ind. Such rail brakes have since been adopted in many American yards, notably at the new Markham Yard of the Illinois Central, at Blue Island, and the Hartford Yard of the New York, New Haven, and Hartford Railway. At Cedar Hill recently a crew of fifteen car riders on the 8 a.m. to 4 p.m. shift is reported to have put 1,130 cars over the hump, there being 802 cuts in these 1,130 cars. This is an average of 53·5 rides per man, and, deducting the twenty-minutes lunch period, equals a ride every eight minutes thirty-six seconds during the eight-hour period.

At Markham there are no less than 121 car retarders and 65 power-operated skates, and at the East St. Louis Yard of the same railway the savings are placed at 36 per cent. The Hartford Yard is being fitted with twenty-nine all-electric retarders, 33 feet long, each controlled from three towers, in addition to twenty skate-placing machines. At Blue Island, where the General Railway Signal Company's all-electric retarders are employed, there are five machines in separate towers, controlling fifty-one car retarders and twenty-nine sets of points. The capacity is reported to be 200 cars per hour, and about 2,750 per twenty-four hours. The average car in the United States to-day may be said to have a capacity of 45 tons. No less than 9,000 feet of retarders were installed in the United States in 1927. In the case of Markham, as well as other yards, the car retarders are worked in connection with skids, or shoes, the skid-placing machine being controlled from the towers. The latest type of skid is that patented by Mr. McGahey, Yard-master of the Potomac Yard near Washington.

In Germany the rail brake system was earlier adopted than in the United States, a fact all the more remarkable in that the average wagon capacity is only about 33 per cent. of the American figure. Several different kinds of apparatus have been tested. Thus the Frolich rail brakes were installed at Cologne (Nippes), the Jordan brake at Wüstermark, and more recently the Frolich brake, made

by Thyssen, at Hamm. At the present time several installations of this latter brake are being put into commission in the various yards of the Essen Division, the policy of the German Railway in this respect being to mechanize a large number of humps and gravity yards, so that the added capacity will enable neighbouring yards to be closed. Thus it is hoped to eliminate twenty-five yards out of the thirty in the Essen Division by concentrating the work in the remaining five. This can only be done if the capacity of these five can be sufficiently increased; the changes made at Hamm would appear to show that this is possible. In one respect the development of rail brakes in Germany and car retarders in America has been very different, for the former has

TABLE XII

Percentage of Time Spent.	Yard equipped with rail-brakes.	Yard not so equipped.
On effective work	72·6	46·4
On non-effective work	17·5	19·6
In waiting.	7·4	34·0
In service work	2·5	
Total	100·0	100·0

developed on the lines of two or four brakes at the base of the hump, whilst in the latter as many as sixty brakes are scattered all over the sorting sidings, as well as at the base of the hump. It will be realized that the former is far cheaper to operate provided the braking is equally efficient. With the Jordan system at Wüstermark, each wagon is weighed as it tops the hump, and the brake pressure regulated according to the weight. By the Frolich method as employed at Hamm, there is no need for this, as the brake pressure is partially regulated by the weight of the wagon itself through a balancing system which allows the braking power to be much stronger and results in a more efficient method.

A complete study of the percentage of locomotive time spent on effective work at two yards in Germany shows the very striking figures given in Table XII.

The German Hamm Yard is also remarkable for its method of point operation whereby the first eight switches are set up in the desired sequence for all cuts of the train before the humping of the train is commenced. This system permits the operation of all thirty-four by one pointsman situated in the central braking cabin. The machine which effects this works on the lines of a calculating machine. Each cut as it passes over a track circuit automatically alters any of the first eight switches necessitated by the correct setting for the next cut. The remaining twenty-six switches are manually controlled but power operated by the pointsman from his cabin by means of a lighted diagram, the wagons by this time being sufficiently separated to permit this. The pointsman receives the train list with required lines by means of a microphone and loud-speakers, the advantage of this system over the teletype system being that verbal communication can be effected, although each type would appear to have certain advantages. The hump locomotive movements are controlled by radio, whilst train lists for the brakesmen are delivered by pneumatic letter service from the reception sidings. An interesting point to note is that the average time in which a wagon is in a German yard is from four to five hours. It is striking that the new yard at Whitemoor near March on the L.N.E.R. is to be modelled somewhat after the Hamm Yard for west-bound traffic in Germany, for automatic point operation will be employed together with the Frolich rail-brake system and flood lighting, the last an improvement on the German yard. A plan of this new L.N.E.R. yard is given in Fig. 24, and the author is indebted to the courtesy of the L.N.E.R. for permission to reproduce it.

Turning to a study of checking marshalling yard efficiency one finds the various units employed in the Monthly Returns of the Ministry of Transport are based on the total number of wagons loaded and empty detached in the yard. The total number of wagons detached per total engine-hour shows whether engine-power has been used efficiently or not ; a low figure will tend to indicate either that the yard is inefficiently laid out or that the engines

are not being used to the best advantage. Other figures show the number of wagons detached per pound of wages paid, and like its predecessor this unit shows tremendous variations, such as from 52 in the case of Edgehill (Liverpool), L.M.S.R., in a recent month where nearly all the movement is done by gravity, to 128 at the large New England yards at Peterboro', L.N.E.R. The number of wagons detached per working day is also important, as it discloses the work done per week-day in the several yards shown. Chaddesden (Derby) gives a figure of 3,821; Crewe deals with 5,310; whilst Toton, just north of Trent on the Midland, gives the enormous figure of 7,449. The last index published of main importance is the wagons detached per man-hour on duty of shunting staff. This unit shows the amount of work done by the shunting staff per man per hour and indicates whether the man-power is being used economically; it will be

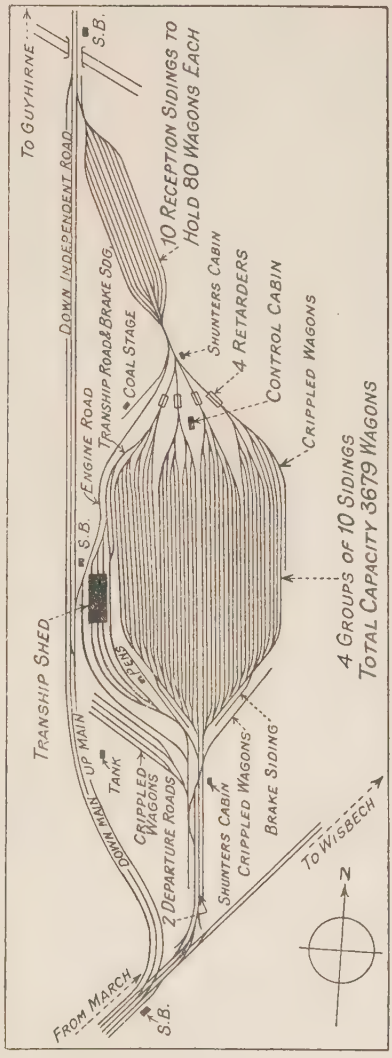

FIG. 24.—New Marshalling Yard on Up side at Whitemoor.

seen that there is considerable variation caused in many cases by conditions such as lighting, room between the tracks, gradient on humps, difficulties with winds, and so forth. No correlation appears to exist between these figures and the fact of whether the yards are flat or humped.

Since the marshalling yard statistics are worked up on most railways from guards' journals, a certain number of complaints are received from yard-masters, saying that the amount of their work, that is wagons detached, has been under-stated. This is mainly due to the fact that, under the Ministry of Transport regulations, a wagon is only counted as detached once in any one yard. On most railways details are kept for every yard, though only a selected number are required by the Ministry of Transport for publication. The best place for working up these statistics—from the guards' journals—is probably in the head statistical office ; one office alone in London receives about 4,000 guards' journals a day. An advantage of this method is that the staff tabulating the figures is free from local bias and favouritism. A disadvantage, however, is that such an office is not in a position to judge, or to check whether a guard's journal has been sent for every train that has been run. The responsibility must necessarily rest on the divisional officer in charge of operation to see that complete files have been forwarded. Figures obtained from guards' journals are checked for accuracy with figures supplied from the locomotive department. Where multiplication of large figures is constantly being done, an electric or mechanical tabulating machine should be installed.

Few appointments can do more to make or mar the efficiency of a railway than that of a yard-master at an important yard. Respecting his own yard he must have full knowledge of the lay-out, siding lengths, number of locomotives in use, and locomotives hours, as also the number of men employed. He should study seasonal changes in traffic in addition to the number of trains entering the yard with average train load and number of cuts per train. His mistakes stretch in their results far

beyond the limits of his own yard, and his good working affects train services all over his line ; in short, he is one of the most important links in the chain of responsibility. A good yard-master must know something of rolling stock, something of engine power rating, and locomotive classification ; he should know a little about rates as well as train rules, and finally he must know how to handle men. A first-rate yard-master should be an outside man with an efficient and trustworthy assistant for inside work ; he must be able to plan hours ahead and to see at a glance from the position of his wagons in the early morning what sort of condition his yard will be in that night. No eight-hours day law can possibly apply to a yard-master, for in one sense his task is heartbreaking in that, however well he schemes ahead, the unexpected invariably happens. But for that very reason his experience is invaluable, and if he wins through, he is the more fitted thereby for the highest posts on the operating side of a railway's work. The yard-master, in short, is a key man, and the position is one from which the most valuable lessons can be learned, which may be summed up under the headings, co-operation, organization, tact, and initiative.

To increase the average wagon movement per day is the goal to be aimed at, and nowhere can greater improvement be made than within the marshalling yard, so as to increase the number of hours per day that the wagon is in actual main line train movement ; in Great Britain much time is lost through the employment of privately owned wagons which amount to about 50 per cent. of the total wagon park, such a system raising the level of freight rates, and necessitating a large added siding and marshalling yard mileage. It also accounts for complaints as to wagon shortage. A case occurred recently where a merchant was unable to supply rockery stone owing, as he alleged, to the railway being unable to supply a wagon. The consumer of rockery stone noticed two wagons of the same sort of stone in the local station yard, but the wagons belonged to a rival supplier of rockery stone, who could not find purchasers ; the second merchant was willing to sell the stone, but was too busy with other

traffic to unload and deliver it, so the first merchant was asked to buy it and use his idle men for this purpose, but he refused on the ground that such a policy would assist his competitor. The moral of this story lies in the delay, congestion, and loss caused thereby to the railway which must ultimately fall upon the consumer. Yet in spite of these terminal disadvantages the British freight service is on the whole very fast, especially with regard to perishable traffic. The Great Western performs some notable runs in this respect, such as the 9·32 p.m. from Old Oak Common, which runs non-stop to Newbury Racecourse Station, and then on to Newton Abbot, a distance of almost 141 miles non-stop, being due at Penzance at 10.40 a.m. the following morning.

The economic problem is primarily that of moving a certain tonnage at the lowest possible cost, and unfortunately in Great Britain, as a result of the small size of wagon, much of that tonnage is dead weight, for it is frequently the case that the tare weight of a train is greater than the paying load it carries. It depends upon the density of traffic as to whether anything can be gained by reducing tonnage to increase speed, for the number of trains required to haul a given tonnage is the most important factor. Increased locomotive power which does not increase the personnel employed, and, consequently, the wage bill, is one method of improvement, for this enables speed to be increased without a decrease in the train load.

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CHAPTER XI

THE ECONOMICS OF ELECTRIC TRACTION

The main theme adopted throughout this book may be expressed by the statement that the form of transport service which offers facilities at the lowest cost in proportion to the quality of the service rendered is the most desirable from the social and national viewpoints, provided that no form of subsidy be included, which would render the cost of the service artificially low. It naturally follows, therefore, that if electric traction should prove cheaper than steam traction it should most certainly be adopted to the largest possible extent, but unfortunately the problem is not so simple as it might outwardly appear. Firstly, the cost basis of comparison, as in the case of so many other railway problems, is by no means easy to achieve, and, secondly, though the cost of electric traction may be somewhat greater than that of steam traction, there may exist certain offsetting social advantages, such as elimination of smoke from city areas, which would result not only in increased health to the community but decreased washing bills, and a general rise in land values in the neighbourhood; none of these latter can with any degree of accuracy be converted into monetary values.

Considerable differences of opinion appear to exist as to the savings to be derived from the generation of electric power within the coal-fields, and its transmission by wire to consuming centres, which would save considerable haulage of coal by rail and water, and free many railway lines for other traffics socially more profitable. At present the larger part of London's electricity supply is generated from coal, mainly brought by coasting vessel, and in a minor degree by rail to power houses, often situated on the banks of the Thames. The problem of an

adequate water supply for generating station purposes within the coal-fields would seem to have an important bearing upon the situation ; water power in itself unless the tides be harnessed can never, unfortunately, be claimed as a large item in our catalogue of natural resources, thus differentiating our position strongly from that of Canada, the Rocky Mountains territory of the United States, and our European neighbours, such as Switzerland, Sweden, Norway, and parts of France and Germany.

It is not without interest that France has recently developed in her reconstructed Pas-de-Calais and Nord mine-fields an important electricity generating scheme, which is gradually supplying current to nearly all those two departments of France, while Germany intends to generate gas in the Ruhr district for despatch to all the large German cities by means of pipe lines. Thus gas and electric light are likely to be serious rivals for house lighting, cooking, and heating in the near future, but for traction purposes electricity, steam, and the internal combustion locomotive are the three important antagonists. The internal combustion engine is as yet comparatively untried ; if refined oils such as petrol be employed in Great Britain, the cost for normal train working is too high to warrant serious attention except in the case of rail motor-cars, while the heavy oil Diesel engine is not sufficiently developed to be regarded as more than in the experimental stage for heavy railway traction, though being a power unit it thereby offers an attraction to the operating officer. Its dependence upon imported fuel will long be a drawback to its employment in Great Britain, as compared with steam and electricity, both generated from home-produced coal ; the strides made by the Diesel locomotives abroad should by no means, however, be overlooked.

Where the cost of electric traction is not greater than that of steam traction, the former holds many advantages, such as the elimination of smoke and the partial elimination of noise, the former permitting use to be made of air rights, which are especially valuable in the limited confines of modern cities. For what may be done in this

respect one has only to mention the uses of air rights over the large Grand Central terminal in New York City, where land values are particularly high owing to the geographical limitations of Manhattan Island. Where water power is abundant and can be harnessed comparatively easily one finds important stretches of electrified railway mileage ; severe gradients which permit the regeneration of current on the downward gradients for return to the power station cheapens the cost on the upward side of the slope, whilst long tunnel sections necessitate the employment of electric traction. Quicker power to accelerate has enabled a reduction of headway on suburban services, thereby increasing materially the seat miles available to the travelling public during a peak or crush period, with the consequence that widespread electrified areas have grown around many of the world's largest cities.

Lack of high mountain ranges and water power resources has resulted in a negative policy with regard to main-line electrification at home ; we have no scheme comparable to the electrified mileage of the Swiss Federal, Midi, Paris-à-Orléans, Italian State, Swedish State, and Austrian State Railway systems ; nor are our conditions comparable to those obtaining in the Pocahontas coal region on the Virginian and the Norfolk and Western Railways, any more than in the Andes or the Rocky Mountains. The British problem of electrification is primarily one of dense suburban passenger traffic working, where to the Railway Company the main advantages lie in a reduced headway between trains, a greater number of seat-miles per hour, fewer engine movements at termini and the more rapid crossing of fouling points at junctions. Especially is this latter advantage of great assistance in the case of the Southern Railway with its very complicated lay-out in the London area south of the Thames, partly as a result of its many passenger termini constructed in the days when competition, and competition alone, was held to be the main essential of adequate regulation.

The history of electrification in Great Britain is closely bound up with the growth of the purely suburban lines, such as the Liverpool Overhead Electric Railway, of

1893, the Mersey Railway, almost wholly a tunnel line except for its Cheshire termini at Rock Ferry, and Birkenhead Park, electrified in 1903, and the various London Tube Railways, of which the first was the City and South London line, completed in 1890 and originally worked with electric locomotives and trailer coaches. Later came the Waterloo and City Tube, subsequently taken over by the S.R., and the Central London, known for a time as the Twopenny Tube, from the method of charging it employed, namely a standard twopenny fare. Later still came the Great Northern and City Railway, the only tube line with a large loading gauge, the Great Northern, Piccadilly and Brompton, commonly known as the Piccadilly; the Charing Cross, Euston, and Hampstead, now usually known as the Hampstead; and the Baker Street and Waterloo, always shortened to Bakerloo. Many of these lines have been extended in more recent years; the Bakerloo to Watford; the Central London has operated for some time over the G.W.R. to Ealing Broadway; the City and South London wholly reconstructed, connected at two places with the Hampstead, and extended to Morden, while the Hampstead has itself been carried as far out of London as Edgeware.

In addition to the tube lines, almost all constructed in the twentieth century, were the much earlier steam passenger railways, namely the Metropolitan District, and the Metropolitan. The former, commonly known as the District, and electrified in 1903, is to-day part of the large "Underground" group, comprising as well as the District, the tube lines and certain tramways in addition to the London General Omnibus Company, and the latter's many associated Companies. The Metropolitan Railway to-day is in a somewhat anomalous situation because it owns the northern part of the famous Inner Circle, which being almost entirely in tunnel sections, was electrified as early as 1905, but in addition it possesses a long stretch of main line finally terminating at Verney Junction in Buckinghamshire. This extension, as it is normally termed, starts from the circle line at Baker Street, the headquarters of the Company, and it is along this route

that the Great Central early in the twentieth century reached the Metropolis. Gradually this extension line has been electrified as traffic warranted until now it is electrified as far as Rickmansworth, while only recently an electrified branch has been completed into the growing town of Watford.

The Metropolitan Railway carries a certain amount of freight traffic on its extension line, but it may be legitimately regarded so far as its electrified section is concerned as a purely passenger line, and like its neighbours, the District and Tube lines, employs the direct current system with third-rail feed. In addition to owning many very well-equipped multiple-unit trains of the compartment and open centre corridor types it also possesses twenty electric locomotives for hauling the steam-train stock over the electrified lines in the city and electrified areas. In conjunction with the G.W.R. it owns jointly the Hammersmith and City line over which jointly owned multiple-unit trains are run through to the city underground stations of the Metropolitan Railway. These are normally operated as six-coach units consisting of two motor-cars and four trailers; the trains have a seating capacity of 320, and the service commenced in 1906. As with the Metropolitan Railway the 600-volt direct-current system is employed, and a fourth negative rail for return is provided in addition to the third-rail feed.

Outside the London area the L.N.E.R. possesses a 28 route-mile section of the late North Eastern Railway in the environs of Newcastle-upon-Tyne, also using the 600-volt direct-current third-rail system with track-rail return, this section having been completed in 1904. Multiple-unit trains are used on this service with a seating capacity of forty-eight first-class passengers in the motor-cars, and seventy third-class passengers together with accommodation for luggage in the trailers. On this section there is a short freight train branch electrically operated leading to Newcastle Quay.

On the L.M.S.R. electrified sections existed on the Midland, Lancashire and Yorkshire, and London and North Western Railways. On the first named, 10 route-

miles were electrified experimentally in 1908 between Lancaster, Heysham, and Morecambe on the alternating current 6,600-volt single-phase system with overhead feed, and employing multiple-unit trains with the vacuum brake. The open centre corridor coaches in use are controlled from either end; the motor-cars, weighing 40 tons, seat seventy passengers, and the trailers fifty-six passengers. The Lancashire and Yorkshire Railway electrified sections were in the densely populated Liverpool and Manchester suburban areas, the first section converted to electric traction being that between Liverpool, Southport, and Crossens in 1904, using the third-rail direct-current 600-volt system. The Aintree and Maghull lines were served by electric trains in 1906, and Town Green in 1911, which together with the Ormskirk line, converted in 1913, totalled about 40 route-miles. A feature of certain of these services was the use of express electric trains to supplement the ordinary electric services, and the multiple-unit trains are for the most part of the centre corridor type, many fitted with reversible seats. The most modern tendency, however, would appear to be the adoption of multiple-unit trains of the compartment type, which facilitates loading and unloading and consequently reduces station time.

The Manchester to Bury 8 route-mile section was opened for electric traction in 1916, using the much higher direct current voltage of 1,200 with the third rail; an insulated fourth rail bonded to the track rails is used in this case. Five-car all-steel multiple-unit trains are employed on the service, seating nearly 400 passengers.

The S.R., however, is the Company which can to-day claim the largest suburban electrified network in the world, its history dating back to December, 1909, when the London, Brighton, and South Coast opened its 8½ route-mile Victoria to London Bridge (South London) section for electric traction, equipped on the overhead feed 6,600-volt alternating-current single-phase system. The success of this electrification in combating road competition was such that the number of passengers carried on this section, which had shrunk from 8,000,000 to 3,000,000 in 1908

prior to the electrification, rose to 10,000,000 shortly after its conversion to electric traction. The 13½ route miles from Battersea Park to Peckham Rye and the Crystal Palace were converted in 1912 on the same system; passengers being carried in multiple-unit sets, though freight trains were still worked by steam.

The choice of the alternating-current single-phase high-tension system with overhead feed was originally due to the fact that the scheme was part of a much larger programme which would have included important sections of the main lines, notably the 50-mile stretch from London to Brighton, and such conditions differed from those applying to suburban electrification alone. The current at a pressure of 6,700 volts is purchased from the London Electric Supply Corporation. The conversion of the next stage of the Central Section of the S.R. was necessarily postponed owing to the war, and to the possibility of changes of policy resulting from the amalgamation clauses in the Railways Act, thus it was not until April 1st, 1925, that further conversion work was completed. These additional 17 route, or 82 track miles consisted of the Selhurst to East Croydon, and Coulsdon North, and the Selhurst to West Croydon and Sutton sections. This added mileage, bringing the total to 39½ route miles, or about 137 track miles, enabled through electric services to be run from Victoria to Sutton and Coulsdon North; the two routes joining at Selhurst. An expenditure of £680,000 was required to equip electrically these 82 track miles, but the service was greatly improved, since at one of the intermediate stations between Selhurst and Victoria in a morning "rush hour" the number of trains was increased from eleven to twenty-two to Victoria.

For the inauguration of the electrical services on the South London section of the high-tension lines, special rolling stock of a somewhat unique design was constructed. In addition to the usual side-doors leading to each compartment, the coaches are provided with passageways, so arranged that on one-half of the coach they are situated on one side, whereas on the other half they are located on the opposite side. A spring door opening

either way divides the smoking from the non-smoking portion of each coach. The idea of the construction was to admit of passengers quickly and evenly distributing themselves inside the carriages. The composition of each unit on this section is one motor-coach and one trailer-coach, the latter being provided with a driver's control compartment. However, the ordinary types of compartment coaches are used for the other early routes ; consisting of three coaches, the units have a motor-coach between two trailers, each trailer being fitted with a driver's control compartment, thus allowing the unit to be driven from either end. The units are run singly or coupled together as occasion demands.

Each motor-coach on the two-coach units has four 115-horsepower motors, while the motor-coaches on the three-coach units are fitted with a similar number of 150-horsepower motors. Working in conjunction with each pair of motors is a 220-kilowatt main transformer for reducing the current from 6,700 volts to 750 volts on the secondary side, and contactors enable the current to be fed to the motors at 510, 588, 706, or 745 volts. An auxiliary transformer, which supplies a secondary voltage of 300, is provided for the control circuits, also for operating the Westinghouse automatic brake compressors and for lighting. The Victoria to Coulsdon North, and Victoria to Sutton services are operated by units consisting of five vehicles each. The centre vehicle is the motor unit giving no passenger accommodation but providing space for baggage and acting as a guard's compartment ; the two coaches at each end are trailers. These units have a seating capacity of 64 first and 240 third-class passengers, and in " rush hour " periods two units are combined to form one train, which thus seats 128 first and 480 third-class passengers. Twenty of these units were required to ensure the service on these two routes when they were opened in 1925.

The difficulties of co-ordinating the two systems of electrification have led to the necessity of converting the present overhead-feed high-tension single-phase alternating-current 6,600-volt system as used on the Central

(London, Brighton, and South Coast) section to the standard 660-volt direct-current third-rail system as used on the Eastern (South Eastern and Chatham) and Western (London and South Western) sections of the Southern Railway. With that object in view the Company, on August 9th, 1926, announced a further large extension of electrification, mainly on the Central section, but also involving certain lines of the Eastern section. Consequently, the whole of the 127 single-track miles of the overhead-feed high-tension single-phase alternating-current 6,600-volt system will be equipped gradually with the direct-current third-rail method, and the third rail will be laid down on an additional 105 track miles at present worked by steam. The cost of conversion of these 232 track miles, exclusive of sidings, it is estimated, will amount to £3,750,000. It will, therefore, for some time be necessary to have certain mileage equipped with both overhead feed and third rail, as trains of both types will require to use these tracks, pending the final withdrawal of the overhead high-tension system. The tracks affected by the 1926 programme were :—

High Tension Lines to be Converted.

Victoria to London Bridge (South London Line).
Victoria to London Bridge via Tulse Hill.
Victoria to Crystal Palace, Norwood and Selhurst.
Victoria to Sutton and Coulsdon North via Selhurst.
Tulse Hill to West Norwood.

These services give at present a train mileage of 2,377,973 a year ; while the following give a train mileage of 2,038,556 a year.

Steam Traction Lines to be Converted.

Victoria via Mitcham Junction to Sutton, Epsom, and Epsom Downs.
London Bridge via Forest Hill and East Croydon to Purley, Caterham, and Tattenham Corner.
Streatham to Wimbledon via Haydon's Road.
Crystal Palace (Low Level) to Beckenham Junction.
Herne Hill to Tulse Hill.

The estimated new third-rail all-electric services are expected to yield a train mileage of 7,636,000 per annum,

an improvement of nearly 100 per cent. on the present steam service and about 50 per cent. on the present high-tension electric service. It is expected that the work will be completed by the spring of 1929, and in the meantime 800 coaches are being converted from steam to electric traction for these services.

On the surface lines of the London and South Western Railway conversion to electric traction was commenced in 1913. Unlike its neighbour the London, Brighton, and South Coast Railway, the London and South Western determined to adopt the direct-current third-rail system for its electric services after a detailed study of both systems. The improvement and acceleration, in this case, of the suburban services were of paramount importance, and therefore the direct-current system was chosen as being most suitable for this purpose. The main objective underlying the policy of electrification was that of counteracting road competition, which was then increasing rapidly. Electric traction seemed to offer the only alternative to additional mileage of widened track, which even if it had been possible could only have been undertaken at prohibitive cost. The original (1913) scheme of suburban electrification on the then London and South Western Railway consisted of the following lines :—

Waterloo to Wimbledon via East Putney	Opened October, 1915.
Kingston "Roundabout" and Shepperton Branch . . .	Opened January, 1916.
Hounslow Loop Line . . .	Opened March, 1916.
Malden Junction to Hampton Court	Opened June, 1916.
Hampton Court Junction to Claygate.	Opened November, 1916.

This same scheme included a later extension from Claygate to Guildford through Cobham, the electrification of which, like that of the London, Brighton, and South Coast Railway programmes, was of necessity delayed by the war and the changes resulting from the amalgamation of the London and South Western, the London, Brighton, and South Coast, and the South Eastern and Chatham Railways which caused an entirely new set of conditions. For the first whole year after electrification the increased

revenue from passengers amounted to £77,000. Additional working costs and maintenance amounted to £120,000, but locomotive expenses were reduced by £73,000; thus the first year yielded a profit of £30,000 after charging revenue with the amount necessary to provide for the replacement of electrification of machinery and equipment when such becomes due.

As soon, however, as a settled policy had been decided upon by the amalgamated Southern Railway the additional programme was pushed on rapidly, and the additional mileage to Guildford was opened to electric traction in July, 1925. In addition a large section of the London and South Western Railway's alternative route to Portsmouth was electrified, that is, from Raynes Park to Leatherhead and Effingham Junction on the Claygate to Guildford section, and also from Leatherhead to Dorking North, the latter being a part of the Central section lines. Naturally the same system of electric traction was adopted as already existed on the older electrified sections of the London and South Western Railway, namely the third-rail 660-volt direct-current system. The 1913 programme consisted of a route mileage of rather more than 50 or a track mileage of about 170, while the further extensions opened in 1925 involved a further 32 route miles or 67 track miles. All these trains are timed to leave the various stations at set minutes past the hour.

On the direct-current lines the introduction of electrically operated trains necessitated alternations to rolling stock which had been used previously for the steam services, and in order to facilitate handling, and to meet, economically, fluctuations of traffic, the multiple-unit system was resorted to, each unit being composed of three coaches, that is, two motor-coaches with a trailer-coach coupled between them. A three-coach unit weighs 94 tons unloaded, three- or six-coach trains being run to meet the requirements. Many trains on the heavier routes have, however, been strengthened by inserting two close-coupled trailer-coaches between two of the three-coach train units.

Ordinary compartment type stock is used on the

Western section, and the unit of three coaches has a seating capacity of 190; there are 110 of these units employed, together with about thirty-five two-coach trailer units for strengthening purposes.

The South Eastern and Chatham Railway had undertaken no conversion to electric traction before the amalgamation, but plans for a large programme had been prepared; though it was left to the Southern Railway to bring them to fruition. The system of electrification chosen for the Eastern Section, like that of the Western Section, was of third-rail direct-current 660-volt type in conjunction with multiple-unit train operation. From the multiplicity of junctions and loops and complexity of services it was essential that electrification, if it was to be undertaken at all, should be on a very comprehensive scale. The wholesale programme of conversion to electric traction was so carefully thought out that no hitch has occurred in its adoption. The programme was divided into three parts, and the first part was opened for electric service in July, 1925, comprising what are known as the "Chatham Lines," which are those originally owned by the London, Chatham, and Dover Railway. These radiated from the London termini of Victoria, Holborn Viaduct, and St. Paul's, and consisted of the services from these stations to Orpington through both Herne Hill and Catford. In addition the branch from Nunhead to Crystal Palace was also electrified.

The second part of the programme consisted of the even more complicated lines of the old South Eastern Railway served by the termini of Charing Cross and Cannon Street, from both of which trains pass through London Bridge, also partially used as a terminus. Opened for electric traction in February, 1926, this second group of lines comprised the routes from the above-mentioned termini to Orpington through Grove Park, together with the branches from Lewisham Junction to Addiscombe Road and Hayes, and totalled 88 track miles costing approximately £1,300,000. Twenty-eight eight-coach sets consisting of two three-coach units and two trailer-coaches each were required to operate these services.

The third part of the programme comprised 72 track miles, conversion cost amounting to about £1,100,000; and was opened in June, 1926. The routes which constituted this third section were the Dartford Lines, that is, the three routes to Dartford from London Bridge through Greenwich, Blackheath, and Eltham respectively. The Greenwich lines for some distance have a fourth conductor rail for amplifying the running rail negative return. Much additional work of an engineering character had to be undertaken besides the conversion from steam to electric traction, if the maximum advantage was to be obtained from the large expenditure made on the electrification itself. For instance, it was essential to alter the lay-out of Cannon Street station as well as of the bridge over the Thames which effects entry into the station, in order to obtain a full service of trains into that station. So that this might be done with the utmost rapidity Cannon Street Station was closed for twenty-three days. The new lay-out was tested on open ground at New Cross, an engineering feature almost unique in railway history. It was found necessary to strengthen many bridges, and to rebuild many stations, such as Herne Hill, Nunhead, and Loughborough, whilst the Catford Loop had to be adapted to take the main line Continental Expresses so that a full service of electric trains might be run through Penge Tunnel.

To secure the maximum benefits from electrification a system of colour-light signals has been installed between Charing Cross and Cannon Street and London Bridge, which are so designed as to give four aspects; namely, (A) Green—All right; proceed. (B) Two Yellows—Be prepared to find the next signal at caution. (C) One Yellow—Be prepared to find the next signal at danger. (D) Red—Stop. As a result of this system it was found possible to dispense with five signal-boxes, whilst in the remaining one the levers are in miniature, the trains by means of track circuits placing the signals at danger after the driver has passed them. The installation of these signals cost £182,000. The Electricity Commissioners, under the Act of 1919, refused to sanction the scheme of

the South Eastern and Chatham Railway to erect their own generating station at Angerstein Wharf, Deptford, with the result that the Southern Railway has been compelled to purchase its current from the London Electric Supply Corporation. It is worthy of remark that the inauguration of electric traction on a considerable mileage had to be delayed because the power company was not in a position to supply the railway's needs, although the railway itself had everything in readiness to operate electric trains on the date originally planned.

In a comparison of the electrification programme of the Southern Railway and of other British railways it is well to remember that until recently railways south of London possessed no coal supplied in their own territories, and even now the development of the Kent coal-field has not progressed far enough to alter the situation materially.

It will be realized that the Southern Railway scheme is notable in many ways, and that Company is to be congratulated upon the courage and energy which it has shown since its formation in overcoming the many difficulties it inherited from its constituent Companies, especially those forming the present Eastern Section, whose suburban services were notably below the general level of those in other districts round London, and in the provinces. Faced with two methods of electric traction already in operation, it determined to standardize upon the type most suited for suburban traction, which meant facing heavy capital loss ; but such a brave policy should deservedly earn an increased net revenue, through the benefits of standardization. The Southern scheme is an excellent example of the inefficiency of comparing electric and steam traction on a cost basis ; the only basis of comparison in such a case must necessarily be the operating ratio in the two cases, and surplus over capital charges in the case of electric traction. Such figures are extremely difficult to obtain, for the train services are not the same and steam trains still operate over the majority of lines now served mainly by electric multiple unit sets.

Statistics for electric traction work must necessarily

be different from those of steam lines, and on the " Underground " Group, where passenger traffic only is dealt with, one has also a system of lines operating trains which run at a uniform speed ; there is no difference of speed caused by freight traffic to look after, and the trains are of standard make up, though alterable in units. The ton-mile in such a case is an impossible unit ; the ton does not exist unless one reckons so many passengers as equal to 1 ton, and as a matter of fact the power used by a loaded or empty " District " train is for all practical purposes the same. The train-mile is never accurate, but especially is it not so here, where for slack periods the eight-car train is reduced to a three-car unit. There is, nevertheless, one very exact unit we can employ as a statistical basis, and that is the car-mile. This is the revenue unit, the operating unit, and the expense unit. It is from the car-mile that one can obtain the seat-miles ; from the number of passengers one could theoretically know how many had to stand, and whether certain trains should be lengthened ; in actual practice one does not know owing to the empty seats in slack periods, hence observers must be employed to watch the loading as well.

Receipts per car-mile is the revenue unit, but it is important to know how far the average passenger travels ; a weekly census is taken on the Underground, though there is the great difficulty of placing the season holder and he is now often asked to mention the stations he usually travels to and from, so as to solve this problem. It is especially important with lines of this nature to keep separate the ordinary, workmen's, season, local, and through tickets issued. Since revenue must be watched very closely, every tendency of change over from bus to tram, or a sudden decrease in season-ticket holders from one station, should be examined at once and an effort made to determine the cause. With this object in view the Underground receive early the following morning a return of the tickets sold at each station the previous day, with the totals for each value of ticket,—say, one penny, three-halfpence, twopence,—in this way any alteration in the distance travelled can easily be traced. The total,

that is the total revenue, of the previous day, plotted on curves should show the trend of passenger movement extremely well and is, moreover, right up to date.

The best index to all expenditure is the cost per car-mile, which can be directly ratioed to receipts per car-mile. Operating ratio, that is the ratio of total operating expenditure to total operating revenue, is a fair index to efficiency with electric lines, as with steam lines, and is the figure one would naturally look at first of all in the case of any railway. There are certain other items of cost which are especially related to operation of city electric railways, such as lift and escalator expenses and station working expenses ; traffic being of a very similar nature everywhere, these can be compared very closely.

Expenses of power have to be studied carefully ; in this country they change with the price of coal per ton as on steam lines, but in the case of Switzerland and other systems which use water-generated power, except for maintenance cost the whole cost is interest on capital expended, and being an invariable sum can be known exactly beforehand, which is very advantageous from the managerial point of view. Other statistical units of power are the high-tension current cost per high-tension unit, as well as the high-tension current used for auxiliary purposes, and low-tension cost including sub-station expenses per low-tension unit.

Figures relative to staff are the same as with steam lines, and for electrical rolling stock the main necessity is, as with steam, to get the maximum mileage, though less need be kept in reserve because, except for the well-known " peak " hours, traffic does not vary greatly, and on most lines such as the " Underground " the only method of increasing capacity is to increase the length of trains, not to run more of them. The car-mile is the basic unit, and especial care has to be taken to keep the empty-car mileage as low as possible in relation to loaded-car mileage ; on the " Underground " the empty-car mileage is the figure which would compare closely with engine-shunting mileage on our steam lines. In such a case of comparison as this, percentage should be the

clearest way of showing the relationship, though possibly an even better method may be the plotting of the points graphically.

The extreme importance of punctuality should be stressed on a line like the "District" or the "Tubes," and for this reason the train passing times are recorded automatically at each station on a chart somewhat on the design of a clockface. It works anti-clockwise, the trains being shown by the lines on the circumference. The method of timing shows up well, with a space between every fifteen trains or so, as does also the tremendous density at crush periods. Provided the morale and discipline of the staff is good, the only real cause of unpunctuality is a failure or breakdown, and as the table shows the effect of a breakdown it is then the task of the staff to eliminate the causes where possible. This is done very thoroughly in the case of the "Underground," and it may be said that the key to their success rests on their elimination of failures.

For the four trunk lines one has tables in the Ministry of Transport Annual Returns and the Monthly Statistics, dealing with electric traction in the case of statistical figures relating to the train-miles per train and engine hour. This in the case of the Newport-Shildon electrified mineral line of the L.N.E.R., which may be regarded as a main line electrified scheme, shows the increased speed attained with the electric locomotives. In addition one has available the low-tension units of electricity used per 1,000 gross ton-miles and the pints of lubricating oil used per 100,000 gross ton-miles, while the figures relating to the electric motor vehicles, showing car-miles per week-day per motor vehicle in use, give one the very high figure for the S.R. of almost 213 miles in a recent month. Such a mileage points to one of the main advantages of electrification, namely the greater number of hours an electric locomotive can be employed per day than its steam rival, due to the fact that the time allotted for locomotive purposes can be reduced to a minimum. Estimates vary greatly as to the percentage of electric locomotives required to replace 100 steam locomotives, but the

optimistic estimates of 60 per cent. made by certain foreign administrations have, in practice, been found to approximate more closely to 80 per cent. and in exceptional cases 85 per cent.

With suburban electric traction the multiple-unit train appears to reign supreme, owing to its increased adhesion and the reduced number of engine movements required in a dead-end passenger station. The Metropolitan, which employs twenty electric locomotives, and the District, which owns seven, utilize these for hauling trains composed of steam-traction coaches from Aylesbury and the G.W.R. line to Aldgate, and from Southend to Ealing respectively over the electrified sections. The remaining electric locomotive stock of the country is accounted for almost exclusively by the twelve freight locomotives of the Newport to Shildon section of the L.N.E.R., which also owns one experimental passenger electric locomotive.

The future of railway electrification in Great Britain is difficult to prophesy ; each large railway now possesses one or more coal-fields within its territory, which tends to reduce its fuel prices ; on the other hand, the widespread scheme of the Electricity Commissioners may make the main railway lines of the country main transmission lines as well. The electrification of the Paris-à-Orléans from Vierzon to Paris was definitely part of a scheme for bringing electric power to Paris from Central France. The Ministry of Transport in 1919 appointed a Departmental Committee to investigate and report upon the position in regard to electrification in Great Britain, and during 1927 a similar committee was again appointed.

Present trends appear to be in favour of third-rail feed with direct current at voltages of about 600 or 660, whilst that of 1,500 volts was advised by the Committee of 1919 ; abroad overhead feed with the high voltage direct-current system appears to be growing in favour, but Great Britain is a country of very short hauls, and perhaps requires a system mainly suited to suburban traction. The third-rail system, however, is quite impossible for marshalling yards and freight depôts, which perhaps explains the policy of the S.R. in adhering to

steam traction for all freight work even over the electrified lines. This policy stands out in strong contradistinction to that of the New York, New Haven, and Hartford, which claims that by converting wholly to electric traction the " peak " demands on the power stations are evened by the current required for shunting and freight haulage during the night. Whilst overhead feed is desirable in many ways, if only from a safety aspect, it tends to obstruct the signal indications and in a sulphurous atmosphere corrosion of the supports is far from being a negligible item.

The viewpoints of society and of a Railway Company are often at variance over the question of electrification ; for the former doubtless regards smoke elimination as a tremendous benefit, while the latter regards the questions naturally from the point of view of financial soundness. The railway operating officer can never forget that the most important disadvantage of electric traction is the dependence upon a centralized power supply. A self-contained unit for railway working is the ideal, and herein lies the strength of the Diesel. Suburban electrification will no doubt extend, but its capital cost is high and the cases in which it should be adopted are those which will result in an added net revenue. The adoption of colour-light signals, and possibly automatic-train control to steam traction, may long delay the progress of railway electrification, which although its conquests have been steady and extensive has not as yet achieved the rapid progress which was at one time expected of it. If electricity were adapted to a self-contained unit for the same cost of operation as a steam engine, locomotive smoke would soon pass into the category of mere memories.

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CHAPTER XII

RAILWAY STATISTICS

Few branches of railway work have developed to a more important degree in recent years than that which deals with the compilation and study of statistics as a means of checking the efficiency of operation and of studying the trends and variations of traffic movement. The earliest returns required by the Government from British railways were rendered necessary by the passing of the Regulation of Railways Act of 1840. These returns related mainly to traffics, and together with provisions requiring financial balances were rendered more explicit by the Companies Clauses and Railway Clauses Acts, 1845. Such powers as were exercised by successive Governments were gradually extended as the century progressed, but related mainly to the two headings of traffic returns and statements of accounts, as was stressed in an earlier chapter of this book dealing with the growth of regulation. Primarily designed to enable the legislative watch-dog to regulate with intelligence an industry rapidly growing and vital to the health of the country's trade, they may be contrasted with the internal statistics designed with the object of enabling those responsible for railway operation and management to supervise those under their direction, and to eliminate growing tendencies to inefficiency. One may therefore term the returns required by the Government as external statistics, although, to avoid the added expense of compilation, they should, if wisely designed, make use of the data which figures on returns necessary for the railway managements.

As early as 1844 one finds the employment of that present basic unit, the ton-mile, on the small Bodmin

and Wadebridge line in Cornwall, for in the Engine Account Book of that Company may be found mention of eight wagons of sand weighing 5 tons carried by the engine "Elephant" $10\frac{1}{2}$ miles, giving a ton-mile figure of 420 tons; in fact, a round trip of 40 miles of this engine appears to have resulted in a movement of $790\frac{3}{4}$ ton-miles, whilst in July, 1845, movement amounted to over 8,600 ton-miles. In view of this early use of the ton-mile in Great Britain it is surprising to find that up to the end of the second decade of the twentieth century it was not required as part of the returns required by the Government from the railways. On the whole, nevertheless, during the first twenty or thirty years of railway operation in this country there was little need for figures to demonstrate to those responsible for management the efficiency of their methods, or figures which would demonstrate that improvements were being effected in the operation of their property. There are many reasons for this, of which three may be stressed.

Firstly, like all industries, operating so soon after the Industrial Revolution, the railway industry was being run on what one, to-day, would call a very small scale. Obviously in the cases of the Liverpool and Manchester and the Stockton and Darlington Railways, to take two lines which form the basis for two of our large systems to-day, there was no need to have a complicated system of statistics. The manager of such a small organization could keep in touch with all concerned personally; he did not require to have statistics to know whether his trains were running late, he probably received quite strongly worded verbal protests from Squire Thompson and Farmer Smith. He did not require statistics to see whether his wagons were loaded to full capacity, probably he saw 50 per cent. of the wagons that were loaded. Lastly, through personal touch he was able to keep the morale of his men high. Instinctively he knew whether Mr. P. was working or not. Thus by the very fact of being small-scale businesses few statistics were required.

Secondly, there was the reason that railways were a new industry, and as with all new industries there is

unlikely to be much attempt to check their efficiency at frequent intervals. All energy was expended on improving their physical equipment, fighting inland water competition and also the long-established coach routes. It was only in times of railway depression that thoughts would turn to the improvement of operation, and even then as far as one can judge the main object was to attempt increased mileage as soon as the financial arrangements could be made. Perhaps this was due to the realization of the fact that the expenses were not proportional to the length of haul, and, consequently, it paid to increase the length of haul, because terminal charges remained stationary.

Thirdly, in the early days of railways, conditions were altering to such an extent that any one set of statistics would have been rendered quite useless at a slightly later period. Mileages were being doubled, types of wagons and carriages radically altered, speeds rapidly increased, together with many other changes, and therefore any figures got out for one year would have proved misleading if compared with even those of the following year. Contrast that position with the problems we are faced with to-day. Instead of having only 100 men working under his direction, the President now has, in the case of the L.M.S.R., approximately 270,000; it would be beyond the power of any mortal to know them by name, much less to know the capacity for work of 270,000, and equally impossible to keep track of the degree of punctuality with which trains are running, or the adequate loading of wagons, unless it be by figures presented to him daily, weekly, and monthly.

In America and the Dominions the problem is rather different for the reason that the President of the railway there, though in most cases not having the density of traffic to deal with or the number of men to superintend, finds that his tracks may stretch over a far greater mileage. The Canadian National Railways has approximately 23,000 miles, and it takes nearly seven days for the President to travel from one terminal (Halifax) to the other (Vancouver).

The importance of statistics is due to the fact that they are a means of measurement of efficiency between two different periods of time and two different places, provided that due allowance is made for two different conditions obtaining at the various times and localities. To obtain these data of the results of operation, and utilization of resources, a standardized system must be developed, for determining the best units to adopt, and to eliminate errors due to the different applications of these units at different times. Statistics are no longer prepared by railways to adorn a general manager's desk, and to impress his visitors ; in fact, his visitors are more impressed if his desk is clear. Their use is not confined to any one group of the community, but can be used by all. There are, however, certain groups to which railway statistics are of especial utility.

The nation should have available the knowledge of what traffic its railways are conducting. Trade statistics form a check on our success as a trading community ; we have grown accustomed to the monthly statistics of the country's trade, which never seem to balance. Similarly the nation has the right to know how much traffic its main form of transportation system is conducting, and with what efficiency the railways are carrying out their economic function. Closely allied to the needs of the country is that branch of it who may be called the traders ; although in actual practice the consumer pays the freight rate, it is the trading community who have allocated to themselves the right to check the railway rates, and to fight for a lower scale if the railway, by its high charges, appears to be reducing the volume of trade movement. But perhaps it is the railway management itself to which statistics are of the greatest use. There can be no question that statistics, if properly used, are one of the best, if not the best, methods by which the supervising officers in each department can check the efficiency of their organization work.

Much of the lack of appreciation of railway statistics is due to the fact that sets of statistics obtained for certain specific purposes are utilized, or are supposed to

be utilized, for the work of other departments. It is impossible to emphasize too strongly the fact that, unlike purely local statistics which can be used equally well by many groups of persons, railway statistical units should each be regarded from the particular point of view of each of the supervising staff by whom they are used. In America the compilation and study of railway—and for that matter of all—statistics receive great attention, and many railroad presidents have their own particular index as to the efficiency of their lines. The art of control by means of statistics lies not in the gathering of whole sets of figures, but in choosing out from that series the one which will give a key to all the others. According to individual opinion these indices will vary and each operating chief or executive officer has his own favourite figure.

At an inaugural lecture of the Chair of Transportation endowed by that famous railway builder, James J. Hill, in the School of Business Administration at Harvard University, Mr. Howard Elliott, now Chairman of the Northern Pacific Railway, maintained that the most intelligent unit of railway expense was the cost per train-mile, because all money paid out for any purpose, whether it be fuel, maintenance of track, doctors' bills, or lawyers' fees, is reflected there. The holder of that Chair of Transportation, Professor Cunningham, himself one of the finest operating officers and railway statisticians in America to-day, pins great faith upon the unit of gross ton-miles per train-hour, as an index to operating efficiency. The choice may vary considerably according to circumstances and viewpoint, but the principle is the same ; one must choose a unit and watch it, but not without relation to its effect on other figures.

There are three main sources from which railway statistical information can be gleaned in this country. These are the Railway Companies' Annual Reports ; the Monthly Statistics published by the Ministry of Transport ; and the Yearly Returns published in Blue Book form, which information is largely a summary of the Companies' annual reports, added to which is a valuable

general report. In the United States, the sources of information are rather greater in number. The first is the Bureau of Statistics of the Interstate Commerce Commission. Then there is the Railway Economics Bureau at Washington, a most efficient organization whose activities are under the direction of Dr. Julius H. Parmelee, an eminent statistician and economist. This Bureau publishes from time to time statistical studies of the effect of freight rates on the cost of various products, in addition to very valuable data on the progress and general position of the American railroads. Finally the Railway Companies' own annual reports are a third source of information, whilst certain other Government departments, such as the Board of Agriculture and the Department of Commerce, give important railroad data. Additionally, there are certain semi-private bureaus, such as the Bureau of Railway News and Statistics at Chicago, run by Slason Thompson, which publishes from time to time important statistics concerning railway matters.

The British Annual Railway Report, submitted to the Annual General Meeting of Proprietors, takes the form outlined for such reports by the Railway Companies (Accounts and Returns) Act of 1911. It should be noted that under this Act the Annual Reports are made to cover the calendar year ending December 31st, and thus relieve the Companies of preparing half-yearly accounts. This 1911 Act was the culmination of a long series of Acts concerning the publication of statistics by the Railway Companies ; there is little need to go into this in detail, but perhaps a few of the outstanding Acts affecting this subject may be mentioned. In 1840 the Railway Regulation Act required returns relating to traffic, accidents, and rates and fares. As early as 1845, less than twenty years after the opening of the Liverpool and Manchester Railway, Railway Companies were required to give certain information regarding their receipts and expenditure, and to make public some form of balance sheet ; this Act was known as the Railway Clauses Act. By the Regulation of Railways Act of 1871 statistics of tonnage and passengers carried, capital and working expenditure, rolling

stock owned, and mileage operated, had been added, whilst within the following decade certain safety statistics had become compulsory, referring mainly to signals and brake-power ; but until the Railway Companies (Returns and Accounts) Act of 1911 was passed it is true to say that the Regulation of Railways Act, 1868, governed the railway returns which were required half-yearly.

Two important Railway Acts have been passed since 1911—the Ministry of Transport Act of 1919, and the Railways Act of 1921. The former brought into our published railway statistics for the first time those all-important bases, the ton-mile and the passenger-mile ; a great controversy had been waged in this country for many years over the value of these units, but after consideration by a Commission they had been rejected in 1911. The Railways Act of 1921 gave the Minister further powers as to the collection of statistical material from the railways, but it would probably be true to say as a generalization that the Annual Report, as we see it to-day, is still in the same form as that laid down by the Accounts and Returns Act of 1911. After giving a List of Directors, there follows the Directors' Report for the past year ; neither of these affect the statistical matter. The remainder of the report may be divided into two portions : the Financial Accounts and the Statistical Returns. The former have been dealt with largely in previous chapters dealing with revenue and expenditure, so that concentration will here be made on the latter.

The first table of Part II, Statistical Returns, deals with the mileage of line, and this is by no means so simple a question as might at first appear. There are two main distinctions to be made when dealing with mileage of line figures ; namely, the length of road, first track, or route mileage, and track mileage, which is mileage of running lines reduced to single track, to which may be added the mileage of sidings, that is to say, the length if all the lines owned by the railway were placed in one single track ; this is commonly known as the total track mileage including sidings. The L.N.E.R. possessed in

1926 a route mileage of 6,630 including its share of joint lines, but a total of 17,183 track miles including sidings. There is, of course, a considerable variation in the ratio of length of road, first track, to the total of single track, including sidings. In industrial areas round large cities one would expect a large proportion of sidings mileage to first-track mileage, and this is well borne out by a study of the L.M.S.R. On that railway in 1925, if one compares the Crewe and Holyhead main line with the Manchester, Blackburn, and Colne main line, one notices that the former had a first-track mileage of 105 miles and a sidings mileage of 70 miles, whereas the latter showed corresponding figures of 59 and 99. If the figures for minor and branch lines are taken, the variations are even more striking. Corresponding figures for the most closely comparable American line, the New York Central, may be of interest. This line possesses a 953-mile main line from New York to Chicago, of which 658 miles are four-tracked. On this 953-mile main line of first track there are no less than 1,924 miles of sidings ; incidentally this gives one a good impression of the commercial density of the Eastern States.

Mileages are divided into convenient stretches : as, for instance, in the L.M.S. Report—London (Euston) and Carlisle, London (St. Pancras) and Carlisle, Derby and Bristol—the branches being placed not separately but in districts, such as the London District or the Glasgow District. In the United States and Canada the usual method is to name each branch separately. There is nothing in this table showing mileage of lines which bears any relationship to the population served by it, and there is little doubt that from the national point of view such figures would be of great interest. Admittedly they would be difficult to ascertain, and the expense of working them out originally, and of keeping them up to date, would be greater than any return which the railways could possibly obtain from them ; any relationship, however, between population and ton-miles and passenger-miles would be valuable data to possess, for inquiries as to the adequacy of transportation facilities in one area as com-

pared to another might be used with advantage for publicity purposes.

Mileage is, of course, the basis of most of the indices used to measure operating efficiency, it appears as one of the bases in ton-miles, train-miles, passenger-miles, wagon-miles, and seat-miles ; further to this are all the combinations of these, such as ton-miles per engine-hour, or wagon-load, which equals ton-miles divided by loaded wagon-miles. There is no excuse for an inaccuracy in actual distances, although admittedly there is an element of difficulty in measuring the distance a wagon may move ; if a cyclometer were fitted to a wagon-axle and the wagon travelled from Whitemoor to Temple Mills there is no question that the figure given by the cyclometer would not agree exactly with the figure derived from the Company's mileage tables owing to such considerations as shunting movements. Every effort should, however, be made to get the mileage base as accurate as possible since it is the starting point of so many other all-important figures.

There are sub-headings of the mileage table showing lines jointly owned and lines leased or worked, and as compared to pre-grouping days these have been greatly simplified, because of the disappearance of such joint lines as the Brighton and South Eastern from St. Leonards to Hastings. As a total, however, they still amount to a considerable mileage, the L.M.S.R. having joint ownership of over 453 route miles, in addition to the route mileage of 6,770 owned entirely by the Company in Great Britain (excluding Ireland). Leased lines are not an important item in this country, though of great importance in America and Canada, where many Companies are non-operating and are worked by powerful neighbours who desire entry into the large western gateways, for instance, over the Mississippi and Missouri Rivers, for competitive purposes. The New York Central possesses a leased mileage of 3,000 miles, or nearly 30 per cent. of its own line.

Mileage of lines authorized but not open for traffic is not of great statistical interest, but it does give some

sort of clue to the railway's future plans, though nowadays the great majority of lines included are connecting spurs of varying importance and widenings. Too much stress should not be placed on this table as an index of the Company's growth and progress, since it takes no account of electrification or the re-signalling of stretches of lines, which are alternatives to the widening process in order to increase track capacity. The ratio of mileage under construction to mileage authorized on the other hand does give a fair indication of what the Company deems it wise to undertake under present conditions: thus, the L.N.E.R. Report for 1926 only shows 11 miles of new lines being built out of 63 authorized, and only 3 miles of widenings out of 150 authorized.

The next set of tables refers to rolling stock: locomotives are divided into tank and tender, and the numbers of tenders are also included. Numbers are given for each group according to wheel arrangement, 4–4–2, 2–8–0, 2–6–0, and so forth. It would be hard to find a table easier to condemn from every point of view. The locomotive is the power unit of the Company, upon its tractive force depends largely the operating efficiency of the line, yet here is a table which gives one no indication as to any increase of power achieved in the year. It may be argued that if ten 4–2–2 locomotives have been replaced by ten 4–4–0, then power will obviously be increased; that may or may not be true. The Pennsylvania succeeded in building an "Atlantic" type locomotive with higher tractive force than an earlier "Pacific." The G.W.R. have converted their "Pacific" into a 4–6–0 "Castle." In a recent year the L.M.S.R. scrapped several 4–6–0 type locomotives and replaced them by 4–4–0's of a more powerful design. Wheel arrangements are most misleading, and superheating if applied extensively to many locomotives in a year will increase power enormously, without altering wheel arrangements at all. The work of the South Eastern rebuilt locomotives on the Continental trains prior to the birth of the "King Arthurs" demonstrates this. In the American reports the amount of information varies very much, but many

of the lines give the increase in tractive effort in the year, which gives quite a good indication of the progress made, whilst other lines give even less information than do our inadequate returns. Tractive effort as a basis of measurement possesses the drawback of not differentiating where the added power is created by the large proportion of freight-train locomotives with small driving wheels.

Particulars of coaching vehicles actually given in the Annual Report are the number of vehicles, and in the case of passenger-carrying vehicles the number of seats or berths of each class, divided into carriages of uniform class, composite carriages, sleeping-cars, and dining-cars ; the cause for the first-named division would appear to be a relic of early Victorian railway regulation. By comparison with the previous year's figures one can work out how much the average seating capacity per carriage has been increased, though such increases in a large Company will be very small each year. Certain information is obviously lacking in this table, such as the percentage of electrically illuminated carriages ; of Westinghouse and Vacuum fitted stock ; of steel-framed to wooden-framed vehicles ; of four-wheelers, six-wheelers, or bogie carriages ; of vehicles steam heated, vestibuled or fitted with corridors. These would all be of statistical interest and, since they are certainly available, should not be costly to include. Besides being useful as an advertisement, it is also information which shareholders should be in possession of, if they are to be interested in their investment.

Shorter tables deal with rail motors, trains worked by electric power, and railway service vehicles, but a much more important table is that which deals with merchandise and mineral trains. This table is important in showing the growing capacity of the average wagon. Primarily divided into open, covered, mineral, special, and cattle wagons, and brake vans, the first three of these headings are sub-divided into those under 8 tons, 8 and up to 12 tons, over 12 and up to 20 tons, and over 20 tons. As on Continental and American railways it is not surprising to find that the larger number of low-capacity wagons are in the covered capacity, whilst in recent years the

tendency has been to increase the number of 12-ton standard wagons, even at the expense of scrapping less efficient types of higher capacity. By comparison with figures for the year before, the increase in average carrying capacity can be roughly judged. The average capacity per railway-owned wagon should reach 11 tons during 1928. It is surprising that no information is given as to the number of wagons piped for automatic brakes, while there is no statistical data available as to the volume capacity of wagons.

The subsequent returns refer to railway-owned road vehicles, steamboats, canals, docks, hotels, and land and houses not forming part of the railway or station, and warrant no special mention since the statistical data concerning most of them are colourless, and give little information, though they are of importance when considered in relation to previous years.

Maintenance and renewal of way and works is important in connection with the total mileage table, for it may be regarded as an efficient index of whether the property is being kept up to a high standard. Figures are given showing the tons of rails, the number of sleepers, cubic yards of ballast, and miles of fencing put in during the year ; all this is useful information and all that is really required, though data concerning the weight of rail put in, and the mileage still laid with light rails would be useful. The British railways obtain a long rail life as compared to foreign countries, with remarkably few rail breakages ; twenty-one years may be regarded as a normal life on a main line, but such a figure can be only approximate since so much depends on the adequate maintenance of the road bed, and the amount of traffic. The employment of a chair would seem on the whole to increase rail life. Percentage of track renewed to total track gives one the all-important figure of the life of rails, if distinctions for replacement can be got at, and the same applies more exactly to the next table dealing with maintenance and renewal of rolling stock.

The estimated life of a British locomotive varies from about thirty to forty years, whilst the same figure could

be applied to passenger rolling stock, though they cannot be accurate owing to the impossibility of estimating the extent to which obsolescent design will apply. The figures shown concerning the percentage of locomotives, carriages, and wagons awaiting repair at any one time are not very illuminating unless they be an average taken for each week-day of the year. Tremendous variations appear in these figures as applying to locomotives ; thus one British railway had a figure of over 21 per cent. in 1923, whilst the United States figures in 1920 ran to almost 25 per cent. ; a typical British figure in normal times would be 10 to 12 per cent., and about 15 per cent. in America. In Germany a high figure of about 25 per cent. was also touched in recent years, whilst the South African Railways' figure at the same time stood at 16 per cent., but a very low figure often results in a large number of locomotive failures in traffic, which create untold expense, and may well outweigh the advantage of a small number of locomotives awaiting repair. The same remarks also apply to carriages and wagons, although not being power units their case is not so important ; about 25 per cent. of our railway carriages receive heavy repairs each year and each one a light repair about every nine months.

One table in the Annual Report is mainly an operating table. Dealing with engine-mileage, it shows the relationship between the number of train-miles run by loaded trains compared with the total, which includes empty mileage ; the same ratio, with reference to freight trains, is also important, and 96 and 88 per cent. may be taken as approximately typical for this ratio for the two types of traffic. The ratio of shunting mileage to total mileage, or the comparison of shunting passenger mileage to shunting goods mileage are also important figures. The ratio of assisting or light-engine mileage to total engine-miles is a figure which should, under the policy adopted by most railways, be reduced to a minimum. This figure naturally varies enormously with individual railway practice, sometimes rising to 10 per cent., in other cases being less than 5 per cent. Such a table shows that the

engine and train-mile are important basic units, but mainly when ratioed to other figures as will be seen presently.

The next table is a traffic revenue table showing the passenger journeys according to classes and the average fare per passenger with similar data for season tickets. Table XIII shows some recent results.

TABLE XIII

	S.R. 1923.	L.N.E.R. 1924.	L.M.S.R. 1925.
	s. *d.*	*s.* *d.*	*s.* *d.*
1st Class	6 3½	5 3¼	6 3
2nd ,, ...	7 2½	1 1	0 5¼
3rd ,, ...	1 4	1 6¼	1 7½
Workmen . . .	0 3½	0 3	0 3¼
Average all fares .	1 6½	1 3	1 3¼

The height of the second-class average in the case of the Southern, the only instance where it is higher than first-class, is largely due to Continental boat train traffic.

Table XIV relative to goods traffic and receipts refers to freight traffic, and gives the average receipts per ton for the different classes in 1924 for all railways.

TABLE XIV

	s. *d.*
Merchandise	16 5
Coal, coke and patent fuel . . .	3 7
Other minerals	5 0
Average for all tons	6 3

The value of traffic hauled and differences in the average length of the haul will explain the variations which exist between the four Companies. The final tables show the tonnage of principal classes of minerals and merchandise and live stock, and demonstrate the general trend of industrial development in the areas concerned, although the classes are so all-embracing as to prevent any tracing of individual increases or decreases. They are published too late for use in any forecasting scheme, and Great Britain possesses at present no data for the purpose comparable

to that furnished on a national scale by the Regional Shippers' Advisory Board scheme in the United States.

Although of only recent employment in Government Railway Returns the ton-mile deserves close attention, for it is one of the most important basic units at home and in other countries where the ton and mile form the means of measurement of weight and distance. In Continental and other countries using the metric system, one finds its equivalent the ton-kilometre. Tons, however, may vary and care should be taken when comparing foreign railway operating statistics with British operation that the varying weights of the ton in different countries are given due consideration. The Continental (French) ton is a metric ton, that is 2,204 pounds ; the American ton consists of 2,000 pounds (or approximately 10 per cent. less). It should also be remembered that Continental distances are usually given in kilometres, a kilometre being five-eighths of a mile, or for approximate calculations two-thirds of a mile. A second point to notice is that a figure of 50 ton-miles may be obtained in many ways. It may, for instance, represent a haul of 50 miles with a weight of 1 ton, or it may represent a haul of 1 mile with a weight of 50 tons. The figure is the same in both cases, but the cost to the Railway Company will be very different since the terminals charge in the latter case will be a very much greater proportion of the whole. A third point to note is the very important difference between gross ton-miles and net ton-miles. The former includes the tare weight of the wagon, the latter does not, and this should be borne in mind, for the elimination of the haulage of non-revenue earning weight is one of the objects which every railway officer should seek to achieve. The desirability of the high capacity wagon largely rests on this, for, generally speaking, the greater the capacity, the lower is the proportion of tare weight to carrying capacity (Chapter X, Vol. I). The lighter the rolling stock the better, provided due consideration is given to comfort in coaching stock and safety and strength in all types of rolling stock.

The importance of the ton-mile is that it is the basis

for so many other statistical units: thus from it is obtained the average train-load (net ton-miles divided by train-miles); the average wagon-load (net ton-miles divided by loaded wagon-miles); and the average length of haul (net ton-miles divided by tons conveyed), with their similar equivalents in passenger traffic. Net ton-miles are given for all the railways—available in the Monthly Statistics of the Ministry of Transport—and separately for the four big groups. These figures are given for three classes of traffic, namely General Merchandise (including live stock), Coal, Coke and Patent Fuel, and other Minerals. They are obtained by multiplying the average wagon-load for the three kinds of traffic, in each case, by the loaded wagon-miles, which are derived from guards' journals. This necessitates knowing the average wagon-load for each class, which is obtained by dividing the total forwarded tonnage by the total number of loaded wagons forwarded. This will be then the average wagon-load at starting-point. With the present grouped systems covering wide areas where average wagon-load would differ considerably, the systems have been divided up into a number of areas and the average wagon-loads in each area are applied to the relative loaded wagon-miles. To sum up, our net ton-mile is based on a calculation of the average wagon-load starting-point in each area, but to obtain the average throughout wagon-load figure, which appears in Government statistics, the net ton-mile figure is divided by the loaded wagon-miles.

Net ton-miles by themselves show whether the volume of freight transportation has increased or decreased; and they might be considered a good index of the country's trade position, though like so many other indices the figures are only available several months afterwards and, therefore, cannot be used for forecasting. The result of reckoning ton-miles and distance by these various methods of calculation is of considerable import. From the operating point of view accuracy will be obtained by measuring the actual distance hauled, that is, it is the measure of work done. From the rates and traffic revenue point of view accuracy will be obtained by measuring the mileage

distance between the point of despatch and the arrival station. The varying effect will be seen on receipts per ton-mile. Receipts per ton-mile are an important figure which is obtained direct from the ton-mile. The variations between the railways in a recent summer month are rather surprising; 2·30 pence being the L.N.E.R. receipt for general merchandise, whilst the Southern Railway's corresponding figure is 3·12 pence. These figures, which are less cost of delivery, worked out at 1·52 pence for all types of traffic, for all the railways. The greater height of the Southern receipts is very largely due to its shorter average haul for merchandise of 48 miles, whilst the L.N.E.R. average haul in 1926 was 64 miles.

During recent years tables have been included in the Monthly Railway Statistics giving the commodity ton-mile statistics which show forcibly the wide variation existing between the receipts per ton-mile at the different lengths of haul. Concerning one commodity, 1 ton carried 35 miles yielded 1*s.* 2*d.* per ton-mile; whereas the average yield per ton-mile for a 45-mile haul on all Companies for the same commodity was 3½ pence. Differences in the value in exchange of the commodity, the varying incidence of road and water competition, and changes in the methods of packing would provide some of the causes for these surprising results, but if plotted graphically each table will illustrate the general tapering nature of railway rates; thus, a table covering brass, copper, tin, and lead shows a receipt per ton-mile of 3·5 pence for a haul of 47 miles as compared with 7·75 pence per ton-mile for a haul of 7 miles. Attention should also be paid to the percentage of ton-miles required of free hauled traffic, such as locomotive coal and ballast, as compared with the total net ton-mile figure, and also to the dissimilar proportion of the three classes of traffic in the different areas of the four railways. Thus, in South Wales, General Merchandise forms only about 19 per cent. of the total traffic, whilst in the Northern Scottish Area of the L.N.E.R. it forms almost 60 per cent.

Average wagon-load, in the various areas, is obtained

by dividing the ton-miles by loaded wagon-miles for the three classes of traffic, and for merchandise, in September, 1927, averaged only 2·9 tons, for all Companies, though possibly volume capacity was fully occupied. Coal, coke and patent fuel yielded a corresponding figure of 9·22 tons, with maxima of 11·85 in the North Eastern Area of the L.N.E.R. and 10·33 in the South Wales Area of the G.W.R., both figures obtained by the use of high-capacity wagons. For all classes of traffic on all the railways the average wagon-load was 5·5 tons for September, showing an improvement on earlier corresponding periods. Average wagon-load at starting-point, obtained by dividing tonnage forwarded by the number of loaded wagons forwarded, gives a totally different set of figures and relates mainly to loading efficiency. The average net train-load in September, 1927, was almost 130 tons, showing a gradual improvement over previous years. The South Wales Area, G.W.R., and the Southern Industrial Area, L.N.E.R., give the maxima figures of 155·5 and 155·1; in the former case this is due to coal traffic and favourable gradients, and in the latter high-powered locomotives, lack of heavy gradients, and a large proportion of mineral traffic would appear to be the main causes. A minimum figure is provided by the Northern Scottish Area, L.N.E.R., with a total of 52·5 net tons.

Turning to the study of other figures derived from the ton-mile, one finds the net ton-miles per train engine-hour (including assisting and light); the net ton-miles per shunting-hour, and the net ton-miles per engine-hour. Net ton-miles per train engine-hour is the ratio of service performed related to the main direct cost of movement; it is, consequently, an important ratio. The train engine-hour is the measurement of time from the engine leaving the shed to returning to the shed, exclusive of time taken for locomotive duties in between. That this figure is looked upon with great interest by responsible railway officers is shown by the fact that all over the world there is a tendency at the present time to increase the length of engine hauls, even though the crews have

to be changed two or three times. New York Central passenger locomotives have worked from Harmon, N.Y., to Chicago, Ill., a distance of 970 miles, and Southern Pacific passenger locomotives 843 miles without coming off their trains, whilst the South African Railways regularly work over 600 miles, though in all these cases stops are made for locomotive purposes. The G.W.R. has increased the length of its runs on the Birkenhead line for passenger locomotives, and for twenty-four years has been operating through runs to Plymouth from London. The L.N.E.R. has been operating London to Newcastle runs of late, and the L.M.S.R. Euston to Carnforth and Carlisle. In certain countries a limit is set to this practice by dissimilar chemical content of the water supply as in Argentina.

A table giving these figures of net ton-miles per engine-hour shows very clearly the effect of a regular policy of double-heading, but does not demonstrate the off-setting punctuality advantage derived. The North Eastern Area, L.N.E.R., in September, 1927, yielded the excellent figure of 1,229 net ton-miles per train engine-hour, whilst primarily agricultural districts are shown up by such figures as 663 for the Western Area, L.M.S.R., which includes the Lake District, though heavy gradients also make for this result. The more advantageous position of locomotive sheds would also tend to the obtaining of a better figure, but with shunting hours which cover the time spent by shunting locomotives when working on their appointed shunting ground (locomotive duties, meal-times, and running to and from the locomotive shed not being included), this difference would not apply. Train engines when used for marshalling are also covered by this heading. Shunting, though absolutely unavoidable, should be cut down to the minimum, since no revenue is really obtained for this, and the longer a wagon is being shunted, the longer it remains in any one area, though, of course, it is true that by obtaining a through train, the wagon may finally reach its destination sooner. In connection with this table, the shunting-hour is counted as equivalent

to 5 miles run. So much for net ton-miles per shunting-hour.

Turning now to net ton-miles per engine-hour, one may regard this as a species of summary for the previous two sets of figures, by including the hours of all locomotives whether shunting, assisting, other (which includes light running) or train engines; the figures fall from 922 net ton-miles per train engine-hour to 448 net ton-miles per engine-hour in the case of one typical Company, that is about 50 per cent. In close relation to the net ton-miles per engine-hour are the engine-miles per day, though these are not a derivative of the net ton-mile. The London and South Western section always obtained good mileage out of its locomotives, and it would seem a pity that these figures, which compare very favourably with the Northern systems, have not been used more as a defence by that Company against uninformed criticism, for the S.R. always shows a good result in this case, being 120 miles for steam traction in September, 1927, and was only exceeded that month by the Metropolitan with a figure of 128 miles. The figure is especially noteworthy when the large proportion of short-distance traffic is taken into consideration, though the small proportion of shunting work undoubtedly offsets this to a large extent. Effect of station turn-round and the average distance of the trains to be hauled will play important parts in the make-up of such a figure.

Net ton-miles per route-mile per working day gives one the key to a Company's average density of traffic. The figure is obtained by dividing the total annual net ton-miles by the number of route-miles and by the number of working days in the year. The density of the L.M.S.R., even in September, is more than three times that of the Southern, being 3,679 to 1,187, whilst the average for Great Britain is 3,007. The generally increasing trend in this figure gives a key to the industrial progress of the country.

While net ton-miles are the number of net tons of freight, revenue or non-revenue, in the wagon or train multiplied by the number of miles moved, tare ton-miles

are the weight in tons of wagons and brake vans multiplied by the number of miles moved. Gross ton-miles is the sum of the net ton-miles figure plus the tare ton-mile figure, and is one of the main statistical operating units in the United States. Where passenger traffic is concerned the passenger-mile may be substituted for the ton-mile in such units as the passenger train load (passenger-miles divided by train-miles).

Until recently the main railway statistical unit in this country, the train-mile (net and gross) remains to-day equally as important as the ton-mile. The train-mile is the movement of one train 1 mile and the train may be defined as a unit of rolling stock in condition for moving over tracks by self-contained motive power; the total train-mile figure is obtained by multiplying the number of trains by the number of miles each train is run. There are many disadvantages of the train-mile as a statistical unit; the mile is naturally a standard measure in length, but there is considerable variation in hauling a train up a mile of line with a heavy gradient to hauling it a mile on a slightly descending grade; contrast the exits from Euston and Paddington or a mile of Shap or Beattock with a mile near Didcot or Northallerton, and if costs are being compared there will be obvious reasons for difference.

The train itself is a most unsatisfactory statistical unit. On the Old Cromford and High Peak branch of the London and North Western, trains were limited to about two 10-ton wagons; the "Consolidation" type locomotives of the G.W.R. are allowed 100 10-ton loaded wagons between Swindon and London; these are extreme cases on the freight-train side. A central section motor-train of the S.R., not counting the locomotive power, weighs with two coaches about 45 tons, whilst some main-line expresses often total up to 450 tons, and even more in summer. Beyond about 600 tons one cannot go, owing to platform lengths which often limit the length, and, consequently, the weight of trains long before this figure is reached. In America the 800-ton passenger train of thirteen steel cars is quite common, and freight

trains of 3,000 tons are hauled. From this it will be seen that the number of train-miles may decrease considerably and yet more work of transporting passengers and freight has been accomplished; this is certainly a serious drawback to the use of the train-mile as a measure of work done. Nevertheless, the train-mile has many advantages. Just as the ton-mile and passenger-mile receipts are the best index to revenue, so the cost per freight and passenger train-mile is the best index to railway expenditure, the reason being that these units include all the operating revenue in the one case, and all the expenditure in the other; hence one may say that the art of the railway management is to obtain the maximum number of ton-miles and passenger-miles from the minimum of train-miles. Another advantage of the train-mile is the rapidity with which this figure can be obtained.

The usual method in this country is for a weekly return to be made either by the Statistical Department, the Traffic Department, or the Locomotive Department, preferably the foremost at the end of each week. In America the train conductors', and on the Continent the guards' returns, are usually the basis for train-miles. The question of checking engine-miles, obtained from the Locomotive Department, against train-miles obtained from the Traffic Department, in the majority of cases hardly warrants the extra clerical expense. For purposes of comparison train-miles are divided into passenger train-miles, mixed train-miles, goods train-miles, mineral train-miles, and service train-miles. Train-miles in our official statistics include miles run by both empty and loaded trains, any train containing loaded vehicles being known as a loaded train. Engine and brake mileage is kept separate, while all shunting trips over forty chains are included; mixed train-mileage is divided between that of freight and coaching-train mileage, while fish, fruit, and perishable train-miles are also divided in proportion to ascertained allocation of receipts.

Total increase or decrease is not a very safe index to trade or national prosperity, for it does not say to

what extent the passenger trains are filled. Train-miles per hour are much more significant as showing the rapidity of circulation of traffic, and the coaching figure is a key to an efficient passenger stock roster, for the increase of speed will be immediately reflected. The figures are obtained by dividing total train-miles by train-hours in traffic, the train-hour including standing at signals, interval between trains, etc. The figure for the L.M.S.R. in the September, 1927, return was 14·0 for steam passenger trains, while the Southern Railway's figure of 16·22 as compared with 13·47 in August, 1924, was very good, as this line has thereby jumped from bottom to top place. It is possible that this change has been obtained as a result of conversion to electric traction of the stopping suburban trains, for the electric motor vehicle train-miles per train-hour are invariably higher and form one of the main advantages of electric traction, the Southern figure in this respect being again the highest at 19·35, also a great improvement on the 1924 figures. The result of providing up-to-date car sheds for maintenance and repair of electrical stock was responsible for an outstanding improvement on one railway not many years ago, but more usually better results are due to many factors, as, for instance, the inauguration of an express electric passenger service or the increase of power of the motors in the multiple-unit trains or such as was recently made in the electric locomotives of the Metropolitan Railway.

Train-miles per engine-hour are a better key to efficient schedules of engine working; it has often been said of English railways that they do not work their locomotives hard enough, and if comparable figures to these could be obtained from foreign railways, the results would be extremely interesting. Unfortunately foreign figures do not appear to be available. In any comparison of this kind certain considerations must be kept in mind, such as the advantages possessed by our own Companies through good coal, softened water, well-laid and tended track, heavy first cost of construction, which should all tend towards the reduction of time spent in

sheds and similarly show a reduction of costs. There are very great variations in this figure of train-miles per engine-hour (steam traction) between the various railways; the Southern, with a figure of 11·1 in September, 1927, as compared with September, 1925, again effected a very satisfactory improvement of 7·4 per cent. This brings out the great use of these tables, which, if watched carefully by responsible officers, tend to bring to a standard the achievements of all the four groups. Before leaving passenger train-miles per train-hour or engine-hour it is worth while bearing in mind that altered railway policies may affect these figures considerably; better signalling methods which will eliminate signal checks, increased tender capacity to avoid waits for coaling, more up-to-date coaling appliances, better standard of upkeep so as to avoid running to and from sheds light at the turn round on each journey, longer runs so as to avoid turn-table time, and so forth.

Train-mile figures for freight traffic are somewhat simpler because only one railway uses electric traction for freight haulage at present, namely the L.N.E.R. on their Newport–Shildon stretch. The average train-mile per train-hour figure for the country was 8·3 in September, 1927, the Southern giving the best figure of 9·5, the L.N.E.R. the lowest at just under 8. These figures vary considerably between the four groups each year. The Southern figure may be accounted for by the comparatively light loading of their trains, namely, 107 tons as an average to that of 135 for the L.N.E.R., which thus adversely affects the speed. It will be seen that train-miles per train-hour of freight traffic are well over 50 per cent. of the train-miles per train-hour of passenger traffic. The contrast between the train-miles per train-hour and train-miles per engine-hour is far more striking with freight traffic than with passenger traffic, due to the large amount of engine-hours spent in shunting duty, and brings out once again the big differences which exist between the two types of traffic.

Wagon-miles as a separate unit have, to a large extent, lost their main importance since the advent of the ton-

mile into our statistics; they are the product of the number of wagons multiplied by the miles run, and represent the total empty and loaded miles of all wagons on trains worked by each Company's engines, though departmental traffic, such as ballast trains, and brake vans, is excluded. They serve to show the use that is made of the wagons, and the loading of trains in comparison to the maximum loading that should be aimed at. In September, 1927, for the whole country wagon-miles totalled nearly 425 million, of which about 68 per cent. were loaded wagon-miles, varying between 65 per cent. on the L.N.E.R. and 70 per cent. on the L.M.S.R.

It would be only guesswork to attempt to explain these variations, since the groups are so large and cover such wide areas, and such varied traffic, that generalizations are not helpful; but one can safely assume that such variations may be caused by the varying percentages of privately-owned wagon haulage and diversified types of traffic, such as banana vans from Avonmouth and Garston to London, meat vans from Liverpool to London, 50-ton bogie brick-cars from Fletton to London, and South Wales coal traffic, all of which entails empty haulage back for loading. A tremendous proportion of this country's freight traffic is uneven in its flow.

Derived from wagon-miles are wagon-miles per engine-hour, but the figure for the whole country of 116 does not merit detailed attention in view of what has been said concerning train-miles per engine-hour. This brings us to the main disadvantage of wagon-miles, namely, the variation in the tare weight, and capacity, of the wagons. Is it fair to compare a 20-ton steel coal-wagon in South Wales, and a 6-ton quarry-wagon; or a 40-ton "Macaw" with a tare weight of 20 tons, and a bolster wagon with a tare weight of 5 tons? There is the same difficulty here as with the train-mile, no standardized unit of measurement, hence little accuracy, still it is apparently no deterrent to the enthusiast who works out such figures to three places of decimals. The same criticism is also true of the ton-mile; no two tons in different commodities are alike in volume, but at any rate the measure of weight

is standardized here, which does give one something definite to work on. The number of wagon-miles per train engine-hour, which includes assisting and light hours whereas the train-hour does not, forms a guide as to whether freight traffic is being worked in an economical manner from the locomotive point of view. Wagon-miles per engine-hour refer only to the hours the engine is " in traffic," whether it be working trains, light running, assisting, or shunting, but hours engaged on locomotive duties are not included.

So far attention has been directed to those statistical data arranged and published by the Ministry of Transport, and while such figures may be termed external, they are also employed internally for the purpose of testing the efficiency of working and of pointing out the weak spots which require attention usually in the form of capital expenditure for physical betterments. In addition, however, there are many sets of figures required for internal purposes only, though in recent years many of these have been called for by Government agencies, and made available to the public. Amongst these latter are very interesting sets of figures relative to the work performed by the marshalling yards, but study of this question has been allotted so much space in an earlier chapter that no added references thereto will be made here.

From the managerial point of view each officer has his own particular figure chosen to check the efficiency of his own work; these figures may be train-mile costs, train-miles per engine-hour, ton-mile costs, average wagon-load, train-load, or wagon-miles per engine-hour. But there is another type of statistics which is got out entirely for internal use, except in so far as the figures obtained are occasionally used for advertising purposes; these figures are not required by the Ministry of Transport, in America they are not required by the Interstate Commerce Commission, nor are they required by more than a very few Government regulatory bodies in the world. One of the most important checks on railway operation is undoubtedly the degree of punctuality with

which trains are run. Several methods are in use for tabulating the figures required for this purpose and several variations occur in the sources from which the data is obtained. Examples of tables designed to show unpunctuality may relate to all passenger trains, to certain chosen expresses, or to all main line important passenger and freight trains. The last is the method most usually employed and there would seem to be no question that in these days of scientifically designed train schedules, it is essential to include the observation of important freight trains, so that delays may be eliminated. The actual table may show the total number of trains run in each division, the percentage run to time, or the total number of minutes lost. In accordance with the office concerned this return might be a daily, weekly, or monthly statement.

Another type of form traces the working of, say one hundred, trains each day, the best method in connection with which is to divide the delays reported into the various district, section, and divisional areas. Thus, if one train suffers heavy delays in one district week after week, obviously it is the duty of the district officer to rectify it. If the total minutes' delay in each district is totalled up for the month, and in some cases they run into hundreds of hours per monthly period, the general manager can see where the weak operating points of his system exist. Figures for these statistics are usually obtained from either one of two sources: where the Control System is in active operation the sheets and records kept in the Control offices are obviously the best source of punctuality figures; in other cases the guards' journals are again the source of information. The type of table adopted to demonstrate the degree of the railway's punctuality which brings out the weak spots in the system, always allowing for difficult weather conditions and troubles caused by shipping, is especially important. Any punctuality table used by sectional or divisional officers should certainly show the punctuality of turns of duty as well as of trains; it is especially desirable to eliminate any regular overtime worked, since extra rates

are being paid per hour to handle traffic which would otherwise be handled at the normal rates.

Whilst each local officer should have adequate information concerning the output of his department, each system or division has its own special traffics, which it regards as a valuable asset to its revenue-earning power ; it may be coal shipment, as in South Wales ; imported-fruit traffic, as at Avonmouth ; live-stock traffic, as at Kansas City ; fish traffic, as at Yarmouth ; or grain traffic, as in the Canadian West. The divisional operating and commercial officers must give special attention to this traffic and arrange to be kept well posted statistically as to whether the situation is being kept thoroughly in hand. Two cases are sufficient to demonstrate this point. Taking coal-export traffic first, the figures one requires must be indicative of ships' capacity to receive cargo and bunker coal, of the amount of coal tonnage on hand waiting to be shipped, of the source of production of the coal, and the estimated tonnage on order. At the port itself figures must be kept to show the cost of shipment per ton, which should bring out the advantages of gravity shipments, electric hoists, well laid out tracks and efficient organization.

Another case is grain in the Canadian West, a traffic of tremendous import, as the season is very limited ; if, owing to weather, the grain is late in ripening, there is very great difficulty in moving the bulk of the crop to Montreal before the St. Lawrence freezes. Thus very accurate statistics have been designed to assist the ease of movement of this crop, for a few cents in the rise or fall of a bushel of grain means prosperity or ruin to thousands of families in the Canadian and American West, and if grain is delayed on the railway through car shortage the whole blame is put on the railways. Grain too late for the St. Lawrence must be sent south-east to New York, Boston, Portland or St. John, for shipment ; lately large quantities have been sent to Vancouver. This rail movement finally ceases about the middle of February, and the following three months are spent in putting the cars in good order ; they must not

be leaky as the grain is forwarded in bulk, and in May empty car trains begin to start westwards in readiness for the season. A statistical return is got out giving the general position as to empty cars, bushels, boats, and the granary position. Not only is this studied very closely, but the railway keeps a daily check on the position in the elevators on its system even although the elevators are not railway owned. This takes the form of a summary grain report; it shows the position for each day in the month; finally, at each Divisional Office is kept a daily telegraphic grain report showing the grain position at every siding in the area. Such internal statistics deal almost exclusively with the operating point of view; there is, however, the financial side to discuss as well, though it is true that even here it is the cost of operation, or, as it is more accurately called on the other side of the Atlantic, the cost of conducting transportation, that is mainly studied.

Amongst the various items of expense on all railways one of the most important is locomotive coal; naturally, each railway knows very exactly the number of pounds of coal consumed per mile, but for comparative efficiency surely this must be related to the average train-load. Published figures covering 1923 show that for the important railways the pounds of coal consumed per engine-mile for passenger, freight, and shunting services equalled 54 pounds, being almost 50 for passenger-train service, almost 65 for freight-train service, and almost 42 for shunting service by shunting locomotives; comparative figures for September, 1927, show the distinct improvement to corresponding figures of 52, 47·8, 61 and 39; these figures speak well for the efficiency of the grouped lines, because September is a month of heavy traffic, although weather conditions are on the whole favourable. Dissimilarity between the figures of the four railways may be due to diversity in the price and variations in the quality of the coal, in the average loads conveyed, the percentage of light running, and low fuel consumption may conceivably be offset by the added costs of maintenance of locomotives with high boiler pressures

and so forth, though probably the adoption of the latter is more advantageous than disadvantageous. Similar figures are available with regard to the consumption of lubricating oil, which has remained more stable.

In view of the high operating ratio figures, and the necessity for the adoption of economy campaigns, the question of terminal costs is being regarded in these days as of great importance. The Railways Act of 1921 split up the rate between a conveyance charge and a terminal charge, and in some well-informed quarters a much higher flat rate to cover terminal costs has been strongly advocated. This shows that the enormous proportion of terminal to actual movement cost is being given very close attention. How is one to set about measuring these costs statistically ? To commence with freight station work may be divided into yard costs, actual station costs and cartage costs. Yard statistics are usually based on the wagons placed for loading or off-loading per hour or per day. It is a moot point to what extent yard statistics and freight station statistics are really operating statistics, but with the normal lay-outs in this country, as at Paddington, Bishopsgate, Broad Street, Bricklayers Arms, and so forth, the working of the freight station and of the yard is so closely connected that it would seem unwise to treat them apart, though under the type of organization employed by our English railways in many cases, the yard working is under the jurisdiction of the Operating Department, whilst the freight station working is under the Commercial Department. In fact the line of demarcation here, as in the case of the running shed, is less distinct and more undecided than between other departments in a railway organization.

For yard working the wagon is probably the best basis of comparison, giving such units as the wagons placed per shunting engine-hour, or wagons placed per man employed, but for the freight station the unit is the ton, loaded or off-loaded. There is a certain body of opinion which prefers the consignment, which at nearly all British freight stations is less than a quarter of a ton,

but for statistical purposes in Great Britain the ton is invariably used. Thus one obtains tons-handled per day or per week per man employed, or the number of tons handled per pound of wages paid; whilst the number of tons handled per gang employed is another typical unit used for comparison.

In no place on a railway can statistics be posted up with greater advantage than in a freight station. If the tonnage of work handled by each gang is posted weekly, a spirit of competition is created which is highly desirable, though it should not be forgotten that much of a gang's efficiency depends on the gang's checker. Statistics should be so arranged as to make calculation easy, as to whether gangs should consist of three, four, or even five men, and whether the average distance trollied is excessive. Recently attention has been drawn, in America, to the lack of statistical information available to compare the work of trollies fitted with electric motors, as compared with the old man-handled method, and at the present time considerable trouble is being taken to draw up efficient statistical tables in regard to this matter. Certain advantages of the electric truck cannot be shown statistically; for instance, in silence, instant movement, the effect of wear and tear on the men employed, and cleanliness; though the effect of speed can be shown largely by tables. Like all motor vehicles, one of the main considerations in their comparison with man-handled trucks is to keep their wheels moving; speed is all-important, therefore, and this brings out a point that is so often met with in studying statistical data, namely, that when some new invention is used, the element of importance, in this case speed, changes as compared with the old method, and hence the basis of tables should change.

The third branch of freight station statistics is that relating to cartage, which is now regarded as an ancillary service and should be self-supporting. It is closely connected with the interior work of the station, for instance, an electric trolly with trailer car can haul one whole load, say 8·75 tons, to the waiting dray; cartage work

is, nevertheless, kept entirely separate in many cases. This has one very obvious drawback, namely if the cartage work is given preference; the gangs are often held up and the loading benches congested; if the internal freight station working is given preference, the carts are often held up for hours waiting to load or unload. By combining the two cost figures, for both are based on the tons handled, and consequently there is no theoretical difficulty, some of the main difficulties are avoided.

Statistics of cartage are mainly a problem of road operating costs and the comparable efficiency of horse-drawn and mechanical vehicles; consequently it will not be more than briefly mentioned here. Cartage costs have been quoted in an earlier chapter and naturally vary widely between different localities owing to street congestion, street gradients, and so forth. The advantage of higher speed for the road vehicle obtained by electrical or mechanical power is offset to some extent by the time occupied by railway cartage vehicles in standing, either during loading, unloading, or traffic congestion. Although many attempts, aimed at the use of demountable flats, have endeavoured to eliminate these delays at the freight station end, little can be done by a railway to lower the standing time at the trader's place of business, or on the streets. Nevertheless the use of heavy horsed vehicles by the railways themselves contributes seriously to the traffic congestion in many large British cities. Comparisons may be based on the minutes occupied by a motor vehicle per ton-mile, divided by its cost, ratioed to the minutes occupied by the horse per ton-mile, divided by the cost of the horse. Thus, while the ton-mile is the basis for cartage work the internal work of the freight station is primarily tons handled per man.

In discussing the statistics of passenger terminals one cannot attempt to include the advertising value of a well-arranged or imposing structure, except in so far as the excellence of its lay-out and design facilitates the flow of traffic. One is deplorably badly off for statistics of passenger stations, which is remarkable considering

the large percentage of revenue derived from passengers in this country. Most of our statistical methods have come from America where as a generalization it is true that passenger receipts do not total more than 25 per cent. of the whole. It is, however, important to reduce costs per passenger transported, whether it be in coal, pounds of wages, or gas for lighting, and, for this purpose, accurate figures must be kept for comparison with previous seasons. The inauguration of oil measurers like those adopted for petrol supply in garages has cut down oil waste very much on the Chicago, Burlington, and Quincy recently, and these were installed after a careful study of statistics.

The reduction of claims, which should first be divided between passengers and goods, has recently been given far more attention than it previously received, and this is a typical case where statistics can be of considerable assistance. There is no reason why the total number of claims should increase at all or why the total compensation paid should increase, though allowance should be made for variations in the price-level when comparing one year with the previous year. In passenger work an increase may be due to an increase of luggage in advance, or to the depredations of a clever gang of thieves, but the tendency year after year should be downwards. Each personal claim should be examined carefully, so as to increase safety as well as to reduce loss. The best basis for comparison is amount paid per £100 of receipts, or per million passengers carried.

Claims by employees for personal injury under the Workmen's Compensation Acts of 1897 and 1906 should also be studied and analysed statistically, and suitable charts to employ might be average period of incapacity, average age of claimant, average amount of cost per case, average weekly earnings, average number of cases per 1,000 employees, or percentage of fatal to non-fatal accidents. There seems to be a regrettable absence of information on the average time taken to settle claims. In America in 1924, 57 per cent. of claims were paid in thirty days, 19 per cent. between thirty and ninety days,

and 14 per cent. after ninety days, whilst the total claims have been reduced from £20,000,000 in 1921, to £10,000,000 in 1924.

One may complete this brief outline of railway statistics with some observations on the more general aspect. It would be idle to deny that statistical methods for controlling railway work are more usefully employed in the United States and Canada than in Great Britain. The transatlantic business executives have brought statistical methods, chiefly of graphical design, to a fine art, not only in regard to railways but other industries as well. The effectiveness of trends expressed graphically is far-reaching and saves considerable time and eye strain as well as leaving a picture in the mind which can be memorized with far greater ease than a mass of tables. The time will arrive shortly when charts will have to be prepared showing the demand and supply curves for individual railway services, a difficult feat but one which would well repay the closest study. To record progress knowledge must be available as to the general slope of the curves, one of which may even prove to be a straight line, and the probable or known points at which they will cut each other.

But it is not only to the highest officers that such graphical diagrams are useful, the yard-master, or even the station-master, may make use of suitably designed charts to help his daily work. For instance, the graph in Fig. 25 shows at a glance the average daily wagon detention in a yard. The marking of a dot and the drawing of a line show the exact position and the approaching danger if the horizontal or vertical lines tend to increase, yet few yard-masters to-day could give one the figures of their yards without reference to their yard statements. Visualized in this way no reference to paper would be required.

British railway statistics for many years had been developed to a larger extent on the late North Eastern Railway than on other railways, even to the extent of using the ton-mile, now standard for all companies, but during the last ten years the published statistics have

been vastly improved and except in one important respect are probably adequate for all reasonable uses both as regards regulation and internal efficiency. In this one respect, however, they are lacking, namely, in total disregard of the Gross Ton-Mile; while Great Britain has always concentrated upon the net ton-mile the United States has also studied closely the gross ton-mile figures. The difference is only natural, because in a country expected to grow by 5 per cent. each year, the stress would rather naturally be placed upon operating cost rather than upon endeavours to obtain added traffic;

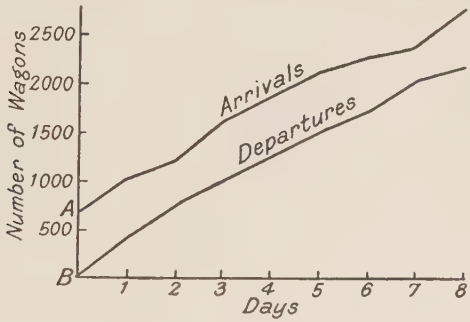

FIG. 25.—Graph showing time spent by wagons in a yard (as used by the Canadian National Railways).

AB = Number of wagons in yard on first of month. Perpendicular distances between the lines show number of wagons in yard at any one time and horizontal distances between the lines show average time of wagons in yard.

in fact throughout British railway history far too great a stress has been placed on the revenue side with the resultant comparative neglect of the cost of operation. The desire to wrest traffic from roads and canals was probably the original cause of this development, but the tendency to-day is gradually changing towards closer attention to operating costs; yet we have no accurate knowledge of the actual tonnage being hauled. Locomotives are rated to load up to 900 tons over a 50-mile stretch of line—a fifty-wagon train is made up, and because a certain proportion of wagons contain coal and others contain merchandise we assume a load of 900 tons has been obtained. A net ton method makes no

allowance for empty wagon haulage whatsoever. Such a system is most unscientific, to say the least, and merits close attention and early remedies. America has developed the gross ton-mile per train-hour unit with great success, combining as it does speed and actual work done,

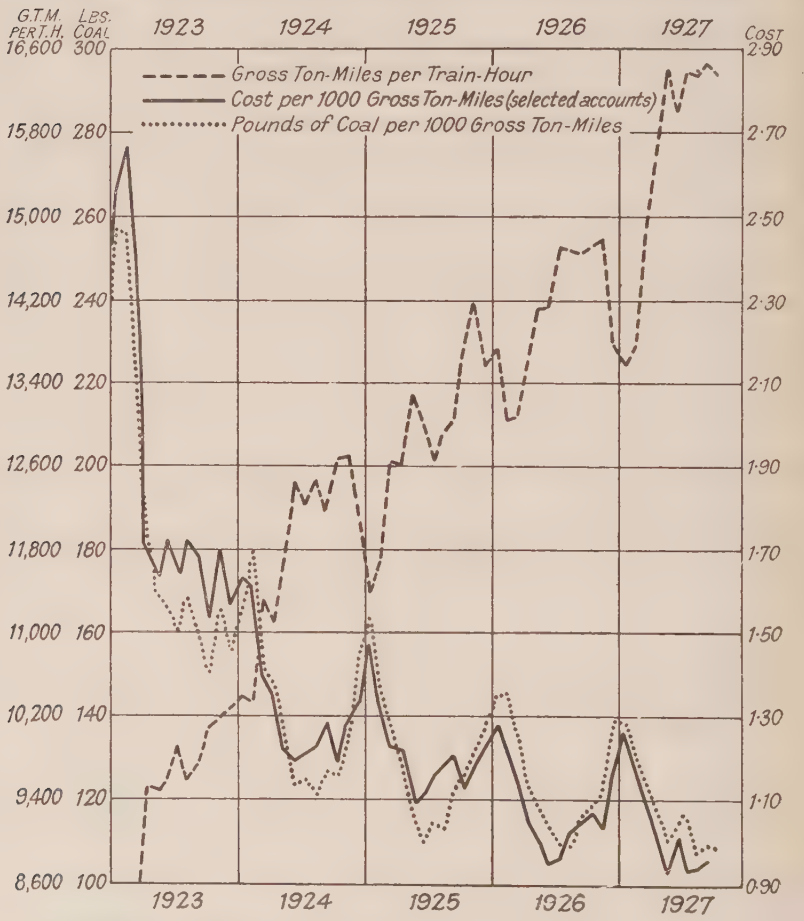

FIG. 26.—Gross-ton-mile chart of the Central Vermont Railway.

not only revenue work, with an easy unit of cost. The effectiveness of a campaign adopted to better this figure is demonstrated by the graph shown in Fig. 26, for permission to publish which the author is indebted to

Mr. J. W. Wardlaw, General Manager of the Central Vermont Railway.

The remarkable results shown in the above diagram were due to a well thought out scheme for increasing operating efficiency, and especially the unit of gross ton-miles per train-hour, which was put into operation by 1924.

It will be seen that the improvement, in part due to better facilities and new locomotives, was not made at the expense of higher costs, for the operating ratio has steadily declined until the time of the flood damage to the railway at the end of 1927.

To sum up, the strength of statistics lies in their power to condense work done and the corresponding costs into a small picture ; their adequacy is imperilled by a lack of knowledge concerning their compilation or by a ruthless use of the trends which they show. The longer the period taken the more accurate is the view of the trend, and graphical illustrations are usually more useful if only for comparative and condensatory purposes than rows of figures. Statistics may be made to prove anything, but those who know the methods of compilation alone will be able to interpret them correctly, and to convince others of their value.

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CHAPTER XIII

ROAD COMPETITION

In an earlier chapter it was shown to what extent transport costs entered into the final selling price of an article. It matters not what we take as an example, whether it be steel for table knives, a loaf of bread, a suit of clothes, or a box of matches. In each case the cost of moving the raw material in the first place, the semi-finished product in its several stages, the manufactured article, and final transport charges for retail distribution are bound to account for a very large percentage of the final selling price that members of the general public, or all consumers, must pay.

Now our wealth is increased by the sum of all satisfactions that we can obtain. Mr. Smith may obtain the maximum satisfaction from a long evening at the "Pig and Whistle"; let us suppose that he is willing to pay four shillings and sixpence for that purpose; Miss Gray may use her four shillings and sixpence to obtain possession of four, so-called, silk handkerchiefs of somewhat varied hue; Master Jones, aged seven, may purchase a miniature type of engine, painted scarlet, with four wheels, to obtain his maximum satisfaction from four shillings and sixpence; but the principle is just the same. Our power to obtain satisfaction is limited by our wherewithal to obtain it, and that wherewithal is measured in money. Thus, it comes about that the more money we can earn, the more are we able to satisfy our wants, and the farther will our earnings go in obtaining the goods made by others.

It will be agreed that the lower selling prices are, the more wants we can satisfy; thus, our wealth as a nation will be greater the lower our prices are in terms of what

we earn, namely, our money wages. How can those engaged on a study of transport help the general public, including themselves, to increase its wealth? The answer is plain: we can transport goods as cheaply as possible so that the selling price of the goods will be as low as possible. It follows from this that it is socially desirable that passengers and goods should travel by the mode of transport which can effect their removal as cheaply, and that is as efficiently, as possible.

If coal can be transported from the Tyne to London more cheaply by sea than by rail, then it is socially beneficial that it should go by sea. Water transport has many advantages over land transport; its permanent way is already made in the case of sea transport and it has no gradients. Like rail transport it has to have expensive terminals in the form of docks, wharves, and loading and unloading appliances, to which might be added the necessity for dredging to keep channels open, and in the case of inland waterways the capital cost of construction may be very heavy. There is also a heavy charge incurred on certain canals for water supply. Unfortunately, transport by water in many cases involves the final delivery of goods overland to reach their destination, and this may offset the savings due to lower power required for movement on water. Its main drawback in these modern days is due to its inability to transport rapidly, except at very exorbitant cost. Our economic structure is so complicated and work is done on such small margins that bulk cargoes, which are most suitable for water transit, cannot be accommodated by many businesses to-day.

In many cases the railways have succeeded in cutting out sea transport by the offer of low rates. For many years Ipswich has had lower rates to London than has Colchester, as the latter had not the good fortune to possess a river from which boats could ply to London. In the earlier days of railways the London and North Western Railway by low rates took traffic from the Grand Junction Canal, which formed the inland water link between London and Birmingham. Combined with greater speed these competitive rates have filched much traffic from

coasting boats and canal barges. The war proved a heavy blow to the coasting trade, as much traffic was diverted to the safer route by rail overland, and this traffic has never returned wholly to the sea route. The important effect of water competition upon the structure of railway rates has already been explained (Chapter VI).

Sufficient attention has hardly been given by the railways to the competition they are likely to suffer from air transport. Here again the rival has no permanent way to keep up, though his engine must give him power enough to overcome the forces of gravity. Terminal charges are not likely to be so heavy as with water transport, in fact air has the advantage that land and water can be flown over with equal ease, thereby avoiding transhipment. It is true that one of the main difficulties at present is to find a suitable landing ground in the centre of large cities, and as such terminals as Liverpool Street, Waterloo, and Victoria are ideally placed, it is possible that some Railway Company may attempt to adapt itself soon to the new means of transport, by commencing a plane service from, let us say, a flattened and somewhat altered King's Cross roof to Newcastle Central roof, possibly stopping at York roof on the way. If passengers and mails are few, it is doubtful whether it would not be cheaper to run by air than by rail in certain cases. The cost per head is higher, but the fare is little more than the first-class charge plus Pullman, or sleeper, the time very much shorter, and wear and tear less. To many the motion is not a sufficient deterrent. There are always passengers and commodities which can, and will, afford to pay a high rate if speed is great and the risks not unduly large.

Thus, one of the most important savings to be derived from rapid air services has been found to be the reduction of insurance charges on very valuable goods, and the interest payable on the transfer of various forms of currency may be reduced to a highly important degree entirely covering the added cost of movement by air. One may take as an example of this the bank cheque clearings in the United States.

There is no question that the most serious form of

transport competition met with by the railways is that of road competition, and that is the form of competition which should be dealt with at some length. With the coming of the motor in conjunction with the excellent system of roads, for which this country has become world famous during the last twenty years, certain traffic was bound to be diverted from railway to roadway, and, if it can be transported more cheaply by road, there can be no question, even from the railways' own point of view, that it is desirable that this conversion should have come about. The added prosperity to the country as a whole, through increased efficiency, will amply repay the Railway Companies in future years.

What are the main advantages for transport of passengers that the road vehicle has over the railway ? Firstly, with regard to long-distance travel, it is the private car that is the main rival of the railway ; in this case it is the advantage of ownership of the means of transport and the power to go where one wills, and the fact that one is not tied to set schedules. It is hard to see how this form of competition can be adequately met by railway managements. Secondly, motor-bus services, which compete with the railways' branch lines, enjoy the advantages of a smaller unit than the railway, of being able to alter routes according to the varying circumstances, such as market days, and most important of all of being able to pick up and drop people at their doors. In bad weather this is often the deciding consideration to many people, and the railways are powerless to change matters other than by running bus services themselves. Lastly, the motor-bus has this important advantage, that it carries its staff with it, there is no question of twenty persons all being paid overtime to deal with a late branch-line train.

How can the railways protect their revenue in this case ? Are they to give up branch-line services, or to run rail-motors, or more frequent branch-line trains ? There has been considerable movement towards the adoption of a light design of rail motor-car during the last four years, and there is little doubt that in certain cases it may serve to increase revenue, but the adoption of a rail motor of

this type which costs, perhaps, eightpence or ninepence a mile to operate under present conditions with a staff of two men, creates important operating problems. Rail motors of a somewhat heavier type were in use on many British lines during the period 1905–1914, and met with varying success. With the self-contained engine, however, any engine defect immediately places the car out of service unless a spare is available, and the latter is a costly system unless many such cars are employed. But there are few branch lines where traffic is suited to their use, for in most cases the passenger train locomotive is required to run the daily freight train, and to carry out the necessary heavy shunting work. On British railways, horse-boxes, special cattle-wagons, and an extra coach for market days are amongst the many extras which must from time to time be added to branch-line trains. A light rail-motor is totally unsuited to such work and is, in short, an inelastic unit.

The economics of the problem resolve themselves into that of balancing first cost of the new car, less the increased passenger revenue, against the extra running cost of a small standard locomotive and branch-line train, less the expense incurred by extra light running of freight locomotives which must cope with the goods traffic of the branch. Theoretically these figures can be obtained and are tangible ; in practice they are unattainable except on estimate. In theory it is easy to find out whether a branch is a paying proposition, in practice one meets the difficulty of apportioning the expenses and revenues correctly between the main line and the branch line. Is the branch line to be credited with its receipts on a mileage basis only, or upon the basis of a feeder which may legitimately be run at a loss, as the increase of revenue to the main line is sufficient to outweigh the loss on the branch ? What proportion of overhead cost is to be debited to the branch, and is this to be apportioned also on a mileage basis ? Until these questions are answered in some reasoned and standardized form it is impossible to claim that branches are being run at a loss.

The strength of the light rail-motor rests upon its cheap

operating costs, which appeals to those searching for economy ; but at present its depreciation allowance and maintenance costs are unknown quantities, and until these are accurately known it is doubtful whether it is a sound principle to embark on a policy of replacing a higher power unit with a lower one. The question of road competition largely hinges on speed, and if branch-line trains, run to smarter schedules, with seconds saved on station time, and consisting of comfortably riding, well-warmed bogie stock, there should be little difficulty in getting back some traffic ; but from the plotting of survey maps to show the points where most passenger traffic has been lost, it is evident that much of it can never be regained. Each case will almost invariably show that the loss has been due to lower speed over long distances between the station in question and the village or town. Figures showing the amount spent on annual passenger travel by rail per head of population also give a guide to the possibility of developing new traffic.

The alternatives suggested—namely, that the railways should run motor-bus and lorry services themselves, or that branch lines should be closed down and converted into motor roads—may each be adaptable in certain individual cases, but each possesses considerable difficulties. It is a matter of doubt if a Railway Company is really a desirable form of organization to run motor services. In cartage and delivery work it appears to have achieved, over a long period of years, a remarkably efficient system, and the Great Western Railway has during the last few years built up an important motor-bus fleet of over 200 vehicles. It is too early to see as yet the financial results of this development ; but in the past where motor-bus services have been run by railways as feeders, the results have been far from remunerative. Railways abroad have long preferred to contract with an established motor operating company to run such services, while the American railways have been careful when entering the motor-bus service field to form subsidiary organizations to conduct their management.

A railway entering the motor-bus or road-haulage field

suffers from labour conditions more strict than those appertaining to the local motor-bus company; it also suffers somewhat from the centralized form of its management and the large-scale size of its organization. Large scale enterprise is most suitable for the business with heavy capital expenditure, with the consequent high percentage of overhead to total costs. Motor-bus services in country districts cannot claim to be operating under such conditions, and whilst there may be certain advantages accruing from railway operation of bus services it is an open question as to whether they are not equally offset by disadvantages, if the form of management is not very highly decentralized. Those who propose the conversion of a branch line into a motor road often forget that the capital cost of conversion would, besides rendering the original cost of the railway almost useless, also create new interest charges which would require to be met out of revenue derived from the traffic which continued to pass. In such cases haulage of coal, for instance, would have to be taken over longer distances by road, a far more expensive method, and consequently socially undesirable. Connections between the local roads and the converted railway would also be costly, whilst the problem of distance between the converted road and the villages would still remain unsolved. In short, the whole problem is fraught with considerable difficulties, and the more it is studied the more is it realized that each individual case demands its own solution, or rather combination of solutions.

There is another form of passenger road competition which is serious from the railway's point of view, namely the season-ticket holder near large cities. The very striking figures in Table XV which were kindly placed at my disposal by the Secretary of the Ministry of Transport, and culled from Government Returns, show the large variations suffered by the old Great Eastern Railway, now part of the London and North Eastern Railway.

The general trend towards reduction in ordinary-ticket holders and the steady increase in season-ticket holders will be evident from the above table. It will also be observed that worked out as a total on the basis of a

TABLE XV.—Great Eastern Railway.

Year.	Number of Passenger Journeys.		
	Ordinary Passengers.	Season-ticket Holders (600 Journeys per Annual Ticket).	Total.
1900	116,103,401	25,631,400	141,734,801
1901	120,718,810	27,310,200	148,029,010
1902	119,478,101	28,578,600	148,056,101
1903	116,711,082	29,568,600	146,279,682
1904	115,664,034	29,703,600	145,367,634
1905	111,876,048	30,290,400	142,166,448
1906	109,764,176	31,050,000	140,814,176
1907	103,374,928	31,346,400	134,720,328
1908	96,336,425	31,615,200	127,951,625
1909	92,678,699	33,035,400	125,714,099
1910	96,125,068	34,474,800	130,599,868
1911	98,329,843	35,469,000	133,798,843
1912	99,689,850	36,611,400	136,301,250
1913	97,172,616	37,153,400	134,326,016
1914–1921 . . .	Not available	Not available	Not available
1922	86,681,531	54,609,000	141,290,531

season-ticket holder making 600 journeys per annum, the peak as regards the total figure was reached in 1902, from which there was a steady decrease until 1909, since which date up to the outbreak of war, occurred a steady increase, whilst the figure for 1922 is almost the same as that of 1900. On the South Eastern and Chatham Railway there was a decrease in ordinary passengers of 30 per cent. over this period, corresponding to the 25 per cent. shown in the above Great Eastern figures ; but on the former the total figures showed a reduction of 10 per cent., while the Great Eastern remained almost the same. The fall at the beginning of the century was presumably due to tramway competition which offset any increase in traffic derived from the expansion of population and the growth of desire to travel.

Table XVI, for which I am also indebted to Mr. Hurcomb, compares the growth of traffic on the tramways

TABLE XVI.—Comparative Statement of the Number of Third Class Passenger Journeys (including 600 Journeys for each Annual Season Ticket) on the Railways of the United Kingdom, and the Number of Passenger Journeys on the Tramways of the United Kingdom, Years 1904–1909

	Railways.						Tramways.		
	United Kingdom.			U.K., excluding Met., Met. District, City Lines and Extensions, Whitechapel and Bow, and London Tubes.			United Kingdom.		
	Millions.	Increase (+) or Decrease (−) over previous period.		Millions.	Increase (+) or Decrease (−) over previous period.		Millions.	Increase (+) over previous period.	
		Millions.	Per cent.		Millions.	Per cent.		Millions.	Per cent.
1904 . .	1,299	—	—	1,095	—	—	2,069	—	—
1905 . .	1,335	+ 36	+ 2·8	1,113	+18	+1·7	2,236	+167	+ 8·1
1906 . .	1,407	+ 72	+ 5·4	1,152	+39	+3·5	2,455	+219	+ 9·8
1907 . .	1,450	+ 43	+ 3·1	1,160	+ 8	+0·7	2,626	+171	+ 7·0
1908 . .	1,481	+ 31	+ 2·1	1,140	−20	−1·7	2,660	+ 34	+ 1·3
1909 . .	1,478	− 3	− 0·2	1,124	−16	−1·4	2,743	+ 83	+ 3·1
1904 . .	1,299	—	—	1,095	—	—	2,069	—	—
1909 . .	1,478	+179	+13·8	1,124	+29	+2·7	2,743	+674	+32·6

of the country with that of the railways during the same period, but the exclusion of the London local railways, at that time being electrified, gives a more accurate picture of the whole position. The increase of only 2·7 per cent. for railway traffic during the period 1904–1909 may be taken as a fair indication of the traffic trend during those years, but it will be seen that during 1908 and 1909 there was an actual decrease in third-class passenger traffic on the railways.

This form of competition is largely a question of comparative fares, and with an equal fare, which is bound to be about a penny a mile, the railway should be able with ease to keep its season-ticket holders. With punctual and efficient services, reasonably frequent trains heated in winter, and a late theatre service once or twice a week, railways should have little to fear, as they should hold the advantage of greater speed. It is sometimes a question of doubt as to whether it is desirable for a Railway Company, other than an underground electric line, to cater for the very short distance suburban passenger. Such service is very expensive to operate, since it must create delay to long-distance trains at crush-hour periods, unless a sufficient number of tracks be available, a position which never appears to exist in Great Britain in dense suburban areas. The case of Liverpool Street on the London and North Eastern Railway is probably the most chronic of all sections of British track, and is an example of what can be done with steam traction, coupled with efficiency and attention to detail.

To those who put forward the claim that a trunk railway should cater for the suburban passenger travelling 1 to 5 miles, on the ground of easing the congestion of the modern city, it might well be explained that such service materially decreases the speed of suburban travel, thereby preventing people from living still further from the scene of their daily exertion. Travel time in recent studies of city congestion and housing has been found in practice to be a stronger force than payment for transport, in preventing the worker from living farther from the city's centre. The real answer to the road competitor for

passenger traffic is for the railway to make its service sufficiently attractive to regain its patrons on the comparatively long-distance haul. In the long run road congestion will do this, but the wise railway management will assist that movement by improving the courtesy of its staff, the comfort of passenger coaches, the cleanliness of its stations, and the speed and punctuality of its service.

In one sense at least the motor-lorry is really a more dangerous competitor than the motor-bus, since under present conditions it tends to scrape away the cream of the well-paying traffic and leave to the railways that most difficult and costly to handle. There are certain types of traffic which are probably more suitable to motor haulage than to rail haulage, such as household removals, confectionery, eggs, all of which are fragile, and where great risk is experienced in transhipping from road to rail and vice versa. Yet, if it be granted that certain traffic can be handled best by road, it is apparent that there is a great deal of traffic handled to-day by road which might more cheaply be handled by rail, often in bulk; for instance, motor-car bodies from Coventry to Oxford, meat from Liverpool to London, vegetables from Lincolnshire and Berkshire to London, cement from Kent to London, cotton from Manchester to Liverpool, Blackburn, and Preston. Why is this and how can some of this traffic be regained by the railways?

The main advantages of the motor-lorry are: firstly, the avoidance of transhipment; secondly, its suitability to 1 to 3-ton loads, often too small for a low rate by rail; thirdly, it pays only part of the cost of maintenance for its permanent way, and no interest upon the original capital sunk in its construction; fourthly, it suffers from no regulation as to an eight-hour day and no overtime rates exist in many cases; and, fifthly, its rates are often cheaper, since there are no station rates, and no general classification of freight,—in fact, its rates are entirely governed by supply and demand. To take these points in turn. Avoidance of transhipment is an advantage which no railway can offer, unless the firm in question has a private siding; the moral, therefore, would be to

encourage private sidings. But even then there is no safeguard that the traffic will go by rail. From a large factory near London, equipped with a well-designed private siding lay-out, perishable traffic is sent by road northwards over 200 miles, though it is only fair to add that about a train-load to towns all over the country is despatched each day.

The suitability of the lorry to carry up to 3-ton loads is an especially difficult one for the railways to counter. If a railway is to operate efficiently it must use the big unit, and, to fill the big unit to capacity, offers a lower rate for a bigger consignment. The use of containers is, perhaps, one way of overcoming this difficulty, and they also, incidentally, save transhipment; but how can a container be devised suitable for packing 16-foot iron pipes one day, and cotton bales the next? Also there is added the weight of the container, which is non-revenue producing. Finally, there is the difficulty of handling the transfer from road motors to railway wagons, or vice versa; this requires some form of mechanical appliance. If one rules out the low rates for small consignments,—and they should be ruled out, as often the small consignment costs as much, if not more than the larger consignment to handle,—then it is a question of competitive service, and it is here that the railway must concentrate on obtaining maximum efficiency. The railway should have the advantage of speed in spite of transhipment, and the speed of certain of our freight trains might possibly be considerably improved. The increasing percentage of piped wagons and the elimination of grease-box axles,—and privately owned wagons are by no means the only offenders,—should go far to make this possible, combined with the steadily increasing engine power. If six-coupled goods engines, designed for main-line traffic in the nineties, are used to-day on some of the more important freight trains, it is not to be expected that railway service can hold its own against new competitors.

As to the problem of payment for permanent way, this is a very debatable question; members of the road haulage industry itself have admitted in recent years that

it did not subscribe its fair share to road maintenance and construction, though the definition of the term "fair share" is not easy to supply. The railways maintain that they are forced to subsidize their road competitors, through the payment of local rates. There is a certain amount of truth in both these assertions.

One has, however, to remember that it is by the roads that all traffic reaches the stations, that the roads are public property. If it was possible to obtain exact details as to the wear and tear caused by the different classes of road haulage, it would be much easier to find a solution to this problem, but little has been done on this work up to the present. It is a vicious system if the taxpayer is really subsidizing the road haulier to transport goods and passengers at a point below the actual cost of the service. There seems little doubt that the road tax rates on heavy vehicles do not always cover the added maintenance costs they make necessary, but the remedy lies with Parliament rather than with the railways in the latter's fight to retain their traffic.

It is grossly unfair that one transport service should be regulated as to conditions of work and rates charged, if its competitor is not so regulated. This country expressed its agreement with the Washington Treaty on hours of work, in spite of the fact that its provisions are totally inapplicable to British conditions, since it makes no allowance for the Saturday afternoon holiday, nor the British Sunday, but if the eight-hour day became law, amended to fit British conditions, one would at least be one step nearer to according the railways fairer competition.

As regards rates and fares, it is difficult to see why railways should to-day be forced to suffer under regulations designed to apply to them when they were for all practical purposes a monopoly. To-day they are a very partial monopoly, and the extent of State regulation ought to be modified accordingly.

Road competition can only be met successfully by increased railway efficiency coupled with the assistance of legislation. It is useless to think out new policies

until the machine, as it exists, functions with maximum efficiency. Personal touch and *esprit de corps* must be kept at highest pitch, and attention directed to the study of the local problems of each district. It is sometimes thought that the railways of this country are the only ones that suffer from road competition. Such is not the case ; the American and Canadian lines have been hit even more seriously. A few years ago the Boston and Maine applied to the Interstate Commerce Commission to abandon 1,000 miles of branch-line track, largely as a result of losses from road competition. The Interstate Commerce Commission's declaration on this application for abandonment included the following, which easily might apply equally to certain British cases :—

" It will be admitted that the people are entitled to the best and cheapest transportation that they can get, and that they themselves must decide what is best and cheapest, all things considered. If people prefer to tax themselves to build great highways, and to use commercial trucks and passenger vehicles in preference to steam railroads, they have the right to their decision, but they must also assume the responsibilities, with the attendant consequence of that decision."

The *Traffic World* of Chicago commented upon this decision in the following sense :—

" The Commission, in this report on the Boston and Maine application, said it had similar applications from other parts of the country. Therefore, the suggestion is believed to be pertinent, that the people of the country are faced with the proposition that as things are now in many parts of the country, they cannot have both improved highways used by automotive competitors of the railroads and the railroads at one and the same time." [1]

Sweden, Germany, Norway, and Australia, all with State-owned and operated systems, have felt the competition of road vehicles severely. Wholesale reductions of staff, totalling many thousands, have resulted in Norway, Spain, and to some extent in the United States. Some of the motor routes are very long, such as the

[1] *Traffic World*, November 28th, 1925.

Boston to New York route, 233 miles, but that is small compared to the El Paso-Vancouver run of 2,200 miles. It seems likely, however, that in the end the example of Germany will be followed, and the basis of co-operation between the two rival forms of transport will be that the rail takes over the long haul, and the road the short haul. The sooner this can be brought about, the better it will be for the future industrial outlook of this country ; but it can only be done when the motor contractors have formed a central body, which can with authority speak for the whole of their industry.

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CHAPTER XIV

STATE OWNERSHIP

In Volume 1, Chapters XI and XII, the growth of regulation by the Government of the railways of this country was traced from the beginning of the railway era. It was noted that the earliest regulation related primarily to the construction of the line, whilst later regulation was mainly directed at abolishing the abuses which arose from financial mismanagement. By the seventies Parliament had begun to deal with the question of safety on the railways, both for passengers and the staff. Doubtless this change was partly caused by the increased speed which trains began to attain in that decade coupled with the fact that traffic was rapidly getting denser. It became unsafe to permit a second train to follow the previous one by simply allowing five or ten minutes to intervene.

For the first time, at the commencement of the eighties rates and fares became the main subject of railway regulation, and it is probably true to say that they have never lost that position of honour. By the end of the nineteenth century conditions of work were becoming a very important feature of railway regulation, and more recently the machinery which was required to be set up to deal with wages disputes has been an outstanding item of railway regulation. If the question be asked as to why railways become the subject of so much closer a degree of Government control than, let us say, the steel industry, it is only necessary to point out that after the eclipse of the canals by the railways, the latter practically attained a monopoly position for inland transport, since the roads were far from good and horse-drawn

coaches and carts could not compete seriously with railways over long distances.

When an industry, which is essential to the life of the country, whose charges enter into the final costs to the consumers of all the articles they buy, becomes virtually a monopoly, if not prevented by law it might attempt to charge all that the traffic will bear. Railways are undoubtedly public utilities, and practically held a monopoly of all internal transport until the coming of the motor vehicle about 1908 ; thus it was quite early realized that the Government would have to exercise some strict control over their affairs.

Nevertheless, like nearly all economic questions there are advantages as well as disadvantages to any adopted policy of Government control. If the railways are not permitted to earn a high rate of profit, they are also normally protected by the Government, so that they will not sink into bankruptcy. Few countries can afford to let railways be absolutely abandoned ; in fact, no important cases of this exist in the world. Even if they get into bad repair, their working will be so inefficient that the Government will be forced to step in and take them over ; examples of this are not uncommon ; there are, for instance, the Canadian Northern, the Grand Trunk Pacific, in Canada ; the French Ouest, which is now part of the Etat, or State system. Thus it is clear that over all public utilities, whether they be Gas, Water, Electric Light, Tramway, or Railway Companies, control of charges must be exercised, in return for which, franchises are granted which are guarantees against competition from rival Companies, and permission granted to the original Company to take over land for its right of way. Without such guarantees no Company would be able to raise the capital necessary to build the railway, or lay the electric light, or gas mains, or build power houses and so forth.

One of the main characteristics of all public utilities is that their first capital cost is enormous, and a large part of their annual net revenue must, as a result of this, go towards paying interest on this borrowed money. As

has been seen in the case of railway capital, much of the original expenditure is immovable and irretrievable. It is especially dangerous for any two railways to enter into violent competition for this same reason ; namely, that capital cost is so high, and it is only possible to make any profit by spreading out these fixed costs over as large a number of customers as possible. Imagine two Gas Companies in one street, one supplying all the even numbers, the other all the odd numbers. Gas mains would have to be doubled, and there would be no more business than if one Company supplied all, in fact probably less, for competition would make the production so expensive that the price would be sufficiently high to make gas cooking less desirable than cooking by oil or coal. Yet the very same kind of thing occurs with the milk dealer ; five dealers may supply one road, only, in this case, there is no fixed capital in the form of water or gas mains. Extra horses, men, boys, and cans form the wasted capital. It will be clear that these public utilities will function with maximum efficiency when there is no direct competition, and by direct competition is meant that between two railways offering a competitive route to the same town, or two Gas Companies in the same street. The application of this principle of the savings of unification may be well exemplified by the Underground group of tube railways in London. Without the above there is plenty of competition. There is market competition, which forces the Londoner to consider whether he shall visit Southend or Brighton, at Easter. Is one going to have rice pudding made with milk from local cows for dinner on Sunday, or is one going to have pears tinned in British Columbia or California ?

Again inter-railway competition has given place largely to road and rail competition, and it is a curious feature of the law which does not permit a rival railway line to be built parallel to an existing line, that it does permit a first-class road to be constructed, while the Government actually assists to the extent of 50 per cent. or more in its construction. Regulation of railways by the Government is, then, essential, and it should be remembered that

it is little use for local authorities to attempt to regulate them ; counties may regulate tramways, but it has been found in America that the central or Federal Government must regulate inter-State commerce, otherwise the laws of individual States will vary, and as regards rates favour will be given to intra-State traffic.

No reasonable person in these enlightened days will quarrel with close Government control of rates, fares, finance, working conditions, wage rates, and a close watch on railway efficiency. To turn now to the more debatable question of whether the nation should own the railway itself ; later will be discussed the question of whether it should operate such a railway. Before discussing the advantages and disadvantages of State ownership of railways, it is wise to realize that such a question as this, like so many economic problems, cannot be answered categorically in the affirmative or negative. State ownership is a very different matter in Central Africa to what it would be in France, Alaska, or China. Each case must be judged on its own merits, taking into consideration racial, economic, and social aspects of the situation.

In highly industrialized countries there are only two examples where privately owned railways supply practically all the transportation service required. These two examples are the United States and Great Britain with which may be included Ireland. It is noteworthy that the population of these countries is primarily Anglo-Saxon. It is also noteworthy that the United States and British railways are looked upon as amongst the most efficient in the world. The season-ticket holder at Brentwood, or at White Plains outside New York, may write to his local paper calling the service he receives at the hand of the local railway disgraceful, but the same man travelling out of Paris to see a friend living in a suburb will tell his French friend that if he had to put up with a service like that at home he might just as well retire from business altogether ; the Frenchman would probably take the same attitude when visiting foreign countries.

Other newer countries where privately owned railways exist are India, Argentina, Brazil, Canada with its Canadian Pacific Railway, China, and to a certain degree Spain, but in most, if not all, of such cases, Government-owned lines also exist. On the Continent of Europe it is noticeable that practically no privately owned large railways exist. The reasons for this are primarily two-fold. Firstly, for strategic reasons, where land frontiers exist which may have to be protected with rapidity, where troops to repel invasions may have to be concentrated in great haste, where defending armies lining frontiers must be supplied with food, clothing, and war stores, there must exist a network of lines behind the frontier. A study of a railway map of France and Germany, or better still a visit to those countries, will not fail to disclose that the trunk and connecting lines have been so constructed as to assist in times of war. The lay-out around Strasburg is a case in point. Secondly, it is part of the Anglo-Saxon nature to invest money; we are by nature a trading nation, and so regarded by all countries of the world. Even Adam Smith in his *Wealth of Nations*, 1776, referred to the British as a nation of shopkeepers. In the 1820's if the local merchants had not seen a chance to profit by supporting Stephenson, no railways would have been built. Americans are the same; both countries have a trading and profit-making sense. The average American in a small town is far more interested in his local trading profits than he is in politics; the average Britisher is the same. On the Continent, national policies, politics, art and so forth occupy a much greater part of life. Thus, it came about that on the Continent of Europe, if railways were to be built at all, the Governments had to build them, and they took care to see that they were built with a view to strategic needs as well. To-day France, Germany, Switzerland, and Belgium all possess Government-owned railways.

A somewhat different cause has accounted for the great mileage of Government-owned railways outside Europe, in South Africa, Australia, Egypt, India, and Japan. In nearly all these cases it was found impossible to raise

enough money from private subscribers to construct railways, because the countries were undeveloped, and it was expected that many years would elapse before any adequate return on the capital could be expected. In short, the competition from other forms of productive investment was too strong. The Egyptian railways were partly strategic, and in India the Government had to build those lines which private enterprise did not consider profitable ; the Intercolonial in Canada, now part of the Canadian National Railway, was built to join Nova Scotia and New Brunswick to Quebec and the rest of Canada, since the Canadian Pacific Railway, while offering a short route between these provinces, runs through United States territory for some 200 miles. The Intercolonial was always a dead loss, but it repaid its construction cost several times over during the war, and has proved a political asset of the highest importance.

Returning to a study of the position in Europe, as it exists to-day, one may well ask what are the social advantages of a State-owned railway. They may be summarized shortly under the following heads. Firstly, there is a certain amount of capital saved by buying the land, as the Government is not forced to pay huge sums to exorbitant landowners. Secondly, there are no taxes on the railway property, and as a result no taxation element enters into rates and fares. Thirdly, capital for new works can be raised at somewhat lower rates, though if one studies railway interest rates and Government interest rates, there is not a great deal perhaps in this advantage, but still in the case of several millions of pounds the savings are by no means negligible. Fourthly, there is also the possible advantage that the sources of production are in the hands of the public. This may prove a disadvantage as well as an advantage if the public administration is not efficient. Fifthly, in the case of national breakdown the railways can be mortgaged to foreign countries, which has practically been the case in Germany as a result of the Dawes Plan. Austria and Belgium have in varying degrees utilized their railways as national assets to produce revenue. It is noteworthy

that in both these cases, the form of Company management has recently been adopted. It must be remembered that a Government is usually in an easier position to raise new capital than a private Company, and, in Switzerland, it is doubtful if the enormous electrification programme could have been carried out unless the railways had been Government-owned. It probably would not have been carried out since, according to the most recent report, it would have been cheaper to operate with steam, but the economic advantage of freedom from imported fuel more than offset the minor financial loss.

What are the balancing disadvantages of Government ownership? Firstly, there is the possibility of political pressure from certain localities which may vote for one political party, a point which will be dealt with more fully in connection with Government operation. Secondly, it is very doubtful if any Government undertakings are as cheaply and efficiently run as those run primarily for profit. Government offices are notoriously inefficient in their conduct of industry. Compare the Post Office to-day with the earlier National Telephone Company, or the Telegraph Service with that offered by the Western Union Company in America. To a certain extent this may be offset by better conditions of work, but in some cases the reverse is true. Compare the cost of construction of a road by local authorities with that of one constructed by contractors; it is invariably more expensive. The fault is mainly due to the fact that the organization of a Government body is not designed to carry on industrial enterprises. There is no single authoritative head and also there is often the hesitation to scrap the inefficient capital. No better example could be found than that of some Municipal tramways, and their lack of will to face facts fully. Thirdly, as a result it does seem desirable to leave private enterprise to supply the need if it will agree to do so, provided always that its profits, at any rate from the production of necessities, are rigorously controlled. The savings thus obtained offset to a large extent the wastes of the system, for much railway capital has been very greatly reduced where no

return could be obtained, that is to say, where the investment was unwisely made.

The case of many financially weak railways whose capital almost disappeared at the time of the amalgamation will be fresh in the memory of many, whilst the Southern Railway lately put forward a conversion scheme which reduced the £100 shares of the London, Chatham, and Dover Railway, which at the time of the grouping were given a nominal value of about £30 as Southern Railway " B " shares, still further to a nominal value of only £13. These shares have only received one dividend in their whole history, namely, in 1922, when the London, Chatham, and Dover Railway was finally eliminated. With Government ownership such a position as this is impossible ; yet this happens daily to the private investor.

The question of the Government buying out the railways, as has recently been proposed with regard to mining royalties, is too large a one to go into here ; but no country's credit, much less our own, could withstand such a blow as it would receive if they were taken over without adequate compensation. A difficult problem arises as to what the basis should be for measuring the compensation. It might be paid-up capital, nominal capital, or earning power, which last named is usually the basis for reckoning the present price of shares on the Stock Exchange. It is hard to visualize, in the case of the railways, any very great advantage in the change over under present conditions, and it certainly would tend to decrease any desire to improve efficiency. It would merely result in issuing more than the present capital, since interest rates would fall to keep in line with all other Government securities. If one assumes that the Government will shortly be able to raise capital at an average rate of interest of 4 per cent., then to convert a $4\frac{1}{4}$ per cent. interest rate, which is what the railways earned in a recent year, to a 4 per cent. basis would mean an increase in nominal capital by one-sixteenth.

Provided a railway is actually owned by the Central Government, how shall it be operated ? Is it to be operated directly by a Minister of Railways, working

through a Commission under whom is a Director-General, as has occurred in various forms on the Australasian railways, in New Zealand, Belgium, Switzerland, Austria, and Germany, until the Dawes Plan came into force? Or is it to be leased out to private Companies to operate as is done in France, where each Company has a virtual monopoly, and where deficits are made good through taxation? There are, in addition, two railways State operated in France, namely, the Etat and the Alsace-Lorraine, which was taken over from Germany after the war.

In between these two policies of extremes has recently been tried a third method which has found considerable favour, and, under certain conditions, appears to operate with considerable success; namely, the formation of a Company organization with balance sheet kept separate from the general budget, and functioning as an ordinary Company would do, with as much independence as possible from Government interference. The Canadian National organization is of this type and under able leadership has been remarkably successful. Many other countries have followed suit, notably Austria, New South Wales, New Zealand, and South Africa. Most recent of all is the case of the Belgian State Railways, which in 1926 became the Belgian National Railway Company. Profits from the German Railway for the time being are accredited to the Reparations Commission to pay reparations, and therefore their balance sheet must be separate from that of the Government budget. Undoubtedly by this system many of the dangers of directly operated Government railways are avoided, but certain outstanding disadvantages of Government operation are still evident.

Thus, the problem of political pressure, though lessened, still exists, and numberless examples might be quoted of the added difficulties placed in the way of the Canadian National Railway by the unfortunate political attacks on its policy. Secondly, and closely related, is the danger that industries which have the smallest power to exercise political pressure, will tend to suffer from the level of rates, which latter should have been more evenly spread over all industries. Thirdly, the possibility of subsidies

obtained through taxation to offset operating deficits, or even those deficits caused by the interest charges on capital which exceed the operating surplus, is a dangerous one, being both socially and economically unsound. Whilst it may be desirable in comparatively undeveloped countries to assist their opening up for a short period by means of very low freight rates which cannot but result in an annual deficit, such a system transgresses the laws of taxation in that the incidence of the tax is unavoidably heavier than the increased freight rate would have been through the added cost of its collection. Fourthly, and perhaps most important of all, is the very great loss which may result from the elimination of the third or neutral party, from disputes concerning wage rates and conditions of work. The rôle of the State in industrial disputes should be that of mediator, but with the State itself taking one side or the other, the danger of a deadlock is far greater.

Against these must be balanced certain advantages ; the first of which arises from the stronger policy made possible by State action. State-operated railways are notable for the firm lines they have adopted on such questions as the private ownership of wagons and heavy demurrage charges. Again there is often a greater degree of standardization of rolling stock, stores, rails, and so forth, though this advantage carries with it the disadvantage of lessened opportunity for inventive genius to gain a good hearing, a point too often forgotten and by no means unimportant. State systems also have advantage in the means they can adopt to protect themselves from road and water competition, but here again such policies are a doubtful asset to the welfare of the nation. Finally, a greater degree of co-ordination is made possible and the routing of traffic by the cheapest route.

To sum up, it is safe to say that in a highly industrialized country the Company type of organization is better suited to operate a business which should run at a small profit. Where private enterprise cannot be prevailed upon to enter the field then the State must take its place. But in either case the railways should be operated with

efficiency and should be self-supporting, so that other industries are not required to subsidize the transport service.

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CHAPTER XV

CONCLUSION

Whereas the study of railway transport in the last century, and during the first decade of the twentieth, is mainly concerned with the problem of regulation by the State, the control of finance, and the desirability of amalgamation, the trend at the present time is towards the intimate study of internal economy, and the increase in operating efficiency, which alone can enable transport charges to be kept at a minimum and permit a country to attain its accustomed share of world trade. Great Britain must strain hard to retain the industrial supremacy in Europe which she had gained through the early development of her heavy industries, upon the exports of which she must largely depend to pay for the imports of food and raw materials which are necessary for her retention of the standard of living to which she has grown accustomed. Her welfare in large part depends upon the ability of her inland transport systems to function efficiently at low cost comparatively for the services they render.

In so far as road transport assists this lowering of cost and betterment of service it is to be eagerly welcomed. Where waste is occasioned by too great a degree of competition between road and rail services they should be more closely co-ordinated, but competition is a healthy stimulus and more damage than assistance can sometimes be created by a too literal adherence to the policy of co-operation. The present controversy concerning the local taxation of railways in aid of road maintenance is no new one, and the following quotation from *A General Description of the Britannia and Conway Tubular Bridges*, 1849, by a Resident Engineer, will serve to remind one

that many so-called modern problems are really those equally shared by one's ancestors, if perhaps presented to-day in slightly different form.

"It is generally asserted by railway proprietors, who are of course self-interested in the question, that the existing practice of rating their respective Companies according to their earnings,—their industry,—or, as it is technically termed, their 'profits on trade,' is unjust, because the same system, or fiscal screw, is not equally applied to landowners, manufacturers, or shopkeepers. It is argued that, so long as our old-fashioned highways, besides levying tolls, are allowed to tax for their maintenance every parish through which they pass, it is unreasonable that the same parishes should at the very same moment, by a process diametrically opposite, be allowed to transfer a large proportion of their domestic rates for the support of their poor, etc., upon railways, which, it is affirmed, have, generally speaking, not only grievously overpaid for the land they occupy, but have materially increased the value and prosperity of every city, town, village, hamlet, and field through which or near which they pass.

"Upon this serious and important question, involving some general re-adjustment of assessments of every description we shall abstain from offering any opinion, because we are convinced that sooner or later it will be duly considered by Parliament. In the meanwhile, however, it is with deep regret that we observe that the innumerable direct as well as indirect impositions and taxes which—rightly or wrongly, legally or illegally—have been imposed upon our railways, are already producing the lamentable consequences we ventured to predict. From want of funds, even our greatest railway companies are openly abandoning branch lines which they had almost completed; they are reducing the number of their trains; economizing at their stations; in fact, in various ways, in proportion not only to the expenses imposed upon them, but moreover to the reductions made in their original Parliamentary tolls, they are—perceptibly as well as imperceptibly—curtailing

the convenience and accommodation which, from a sound regard for their mutual interests, they would most willingly have maintained for the public.

"We feel confident that in this unfortunate, short-sighted, narrow-minded conflict the British Nation is discreditably warring against itself; and having not inattentively watched the practical working of the system, it has been our humble endeavour—by a few pen-and-ink sketches, which we now conclude—to attract the attention of the public to the magnitude of the works of our arterial railways, in order that, from the good sense and good feelings of the community, these new highways may receive that fostering protection and genial support without which the fruits of Science cannot be matured."

Whatever may be the outcome of the present position it is clear that for short hauls and small retail consignments the lorry provides a cheaper and often more prompt service than the railway can possibly offer. For wholesale traffic either as regards bulk shipments, or for long distances, its pre-eminence departs, and it is clearly out of place, being a menace to railways in its present unregulated state.[1] The railways should certainly assist the use of both the bus and the motor-lorry in their legitimate fields, and co-ordinate in so far as is possible the two methods of transportation; but where ruthless competition for traffic not sufficient to warrant the two systems is taking place, its development should be opposed provided the rail method satisfies public wants, and can be operated more cheaply. The railways of Great Britain hold a great advantage in their control over warehouse accommodation, enabling them to hold traffic until the consignee is able to receive or reconsign it, and this advantage should prove of considerable value, as it has done already in the case of the rail head schemes developed in recent years by the L.M.S.R.

Earlier chapters have shown the vicissitudes through

[1] Report of the Committee on Economics of Railway Operation, at the 1927 Annual Convention of the American Railway Engineering Association.

which most of the component parts of the British railway system had to pass at one time or another; some of them even possessing labels upon their rolling stock notifying the passenger that the vehicle or locomotive in question was the property, not of the railway, but of, perhaps, the Lord Chancellor. No harder test has ever come than during the year 1926, so disastrous to national welfare and industrial progress; it may be that such turmoil will result in industrial peace during the coming years, and indeed efforts are being concentrated upon that desired objective, but only a better understanding of society's wants and needs can result in the long reign of prosperity, which will be attained solely through a real appreciation of underlying conditions.

This book has purposely avoided the troubled waters of personnel problems; they deserve a study to themselves, and the economic theory relating to wages refers not only to the railway industry but to many other industries as well. Bonus systems based on savings in operating expenses, as adopted by the Southern Railway of the United States, and in a very definite form under the French Railways Act of 1921, would appear to be a natural corollary to any complete scheme of co-operation between the railways and their staffs. A Company is often more dependent on its employees than the latter are upon it, and it is the duty of both to work together for their own benefit and that of society. The railway employee who is inefficient sometimes escapes the results of inefficiency, but in certain cases he is brought to book, as resulted from a letter by a firm to a certain Railway Company which called the latter's attention to the fact that it had received for many years a thirty-page booklet giving the freight charges on bricks. The letter suggested that it would save money and time if the railway addressed it to the new address, since the old offices had been vacated thirteen years before; and, secondly, that the brick charges were really not required, as the firm had never dealt with bricks in its history!

The most important trend to-day, both in regulation and to assist internal efficiency, is the growing demand

for increased cost data, and the growing use of statistical matter. As explained recently,[1] the figures now published by the Ministry of Transport enable one—

(1) To obtain a detailed picture of the state of employment in the railway industry, including particulars of the number of employees in each grade and the average weekly wages and average weekly earnings compared with previous years.

(2) To obtain a reliable record of the equipment owned by each Railway Company and to see the extent to which it is being maintained.

(3) To see how many engines, carriages and wagons of each description have been built or purchased, and how many have been condemned; also the number ordered and numbers outstanding.

(4) To see the extent to which use is being made of the stock of locomotives, motor vehicles and rail motors, and to obtain some idea of the relationship between the available stock and the maximum requirements.

(5) To calculate the quantity of coal, electricity and oil used per engine mile, by locomotives and rail motors.

(6) To obtain a detailed analysis of the revenue obtained from passenger and freight traffic and to watch the effect of changes in rates and fares.

(7) To calculate the average distances travelled by passengers holding various descriptions of tickets and the average lengths of haul of freight traffic.

(8) To ascertain the volume of freight traffic dealt with as measured by tons, ton-miles, and loaded ton-miles.

(9) To observe whether the proportion of empty wagon miles is increasing or decreasing.

(10) To calculate the average wagon load for the three main classes of traffic, i.e., general merchandise, coal, coke and patent fuels, and other minerals.

[1] A. E. Kirkus, "Railway Statistics," *Proceedings of the Railway Students' Association*, London School of Economics, 1925–1926.

(11) To calculate the average load of freight trains as measured by wagons and by tonnage.

(12) To calculate the average number of train miles per train hour for coaching and freight services and to ascertain also the average rate of movement as represented by the number of train miles run in relation to the total engine hours worked.

(13) To calculate the number of "ton-miles per engine hour"—probably the best and certainly the most comprehensive of all statistical units for testing the efficiency of freight train working; and

(14) To watch the results of working in marshalling yards and goods depôts, and of cartage staffs.

It is upon such data that regulation of the nation's most important inland transport system rests, and the work of the Railway Rates Tribunal is also dependent upon these figures for its decisions regarding the charges which may be made, because the standard revenue is only to be earned under conditions of efficient and economical management.

Internally cost data has become essential for a railway's own officers, and for much of the present progress in this direction we owe a debt to American efforts. Albert Fink,[1] the centenary of whose birth took place in October, 1927, was one of the first to attract attention to the study of the economics of railway operation by his work in the annual reports of the Louisville and Nashville Railway. His most famous report was that of 1874, entitled *The Report of the Vice-President and General Superintendent*, which became widely known as "The Fink Report on Cost of Transportation," but the basis of American Railway Economics is his *Investigation into the Cost of Transportation on American Railroads with Deductions for its Cheapening*, published early in 1874. The United States has produced many classical works on this subject,

[1] Albert Fink. October 27th, 1827–April 3rd, 1897. *A Bibliographical Memoir of the Father of Railway Economics and Statistics in the United States.* Bureau of Railway Economics, Washington, D.C., October 27th, 1927.

notably by Mr. A. T. Hadley, President Emeritus of Yale, and Wellington's *The Economic Theory of Railway Location* ; whilst the more modern works of W. Z. Ripley, T. W. Van Metre, E. R. Johnson, H. B. Vanderblue, K. F. Burgess, and W. J. Cunningham, stand out amongst many excellent studies.

Europe, in spite of the efforts of Monsieur Colson and the late Sir William Acworth, lags as yet far behind, but the need is vital and every effort should be made to make up for lost time. The costing problem on a railway is full of pitfalls and intricacies ; few other industries can claim that only about one-third of their maintenance charges is influenced by the traffic they handle. Fluctuations of trade and the revolution of the trade cycle create special difficulties for an industry with such a high percentage of fixed costs, and to-day wages scales are rapidly taking upon themselves the form of a standardized rather than a fluctuating nature ; whilst prices on the whole have been steadily falling, money wage rates have remained almost constant, with the consequence that the real wages, as measured by purchasing power, have increased. Numerous studies have been made in recent years to determine the extent to which expenditure varies with the amount of work done, as measured, for instance, by train-miles, and some remarkable work in this direction has been achieved by an Indian railway. Each individual country, however, must develop a system of its own to determine these essential facts, and even wide variations may be disclosed between the railways operating under apparently similar conditions. Again, in each item of expenditure that varied by changes in the traffic carried will be dissimilar, say by 20 per cent. for permanent-way renewals and maintenance to 100 per cent. in the case of delivery and collection of goods.

The railway problem, like that facing all offering transport services, is in essentials to make the maximum use of the facilities created by the heavy capital expenditure involved and to spread the interest charges required by that capital over the largest number of revenue producing units possible. The work of the Interstate

Commerce Commission Bureau of Statistics is probably unexcelled, and their cost figures with regard to operating expenses and taxes throw useful light on the residual net railway operating income which is the return on capital available to the investor.

The division of expense items between freight and passenger service is of supreme importance to those responsible for the design, adjustment, and regulation of the level of passenger fares and freight rates ; whereas train-mile costs can be employed for passenger and freight service, ton-mile and passenger-mile figures are separate statistical units to which it is difficult to allot respective weights in order to bring them to a common denominator. The train-mile is unsatisfactory in view of the diversity of costs over varying gradients, lines with high traffic density and so forth, while the train is an inexact basic unit. The train tends to increase in weight in spite of the greater train mileage forced as a result of strong road competition, although the latter induces a greater tare weight in proportion to revenue tonnage by the use of containers and other similar methods ; in fact the container, desirable as it may be, transfers the cost of packing from the trader to the railway. The tendency towards a greater degree of retail trading has offset the progress made over one hundred years towards cheapening costs of transport by bulk movement, and the average wagon-load of under 3 tons for merchandise is probably not much greater than the average wagon-load in the early Victorian era. That some heavy loads were being run at that time is clear from Sir John Aspinall's Hawksley lecture [1] in 1925.

While the savings to the community of retail buying are doubtless great, through the savings of interest on capital investment, this advantage must, to an important extent, be offset by increased transport and production charges, for with machine-industry retail production cannot be as cheap as mass production. Nevertheless,

[1] *Railways of the Past and the Present*, by Sir John A. F. Aspinall, the Twelfth Thomas Hawksley Lecture, delivered to the Institution of Mechanical Engineers on November 6th, 1925.

the incidence of freight rates upon the cost of living appears unexpectedly small,—in fact, quality of service would seem to be a more important consideration to the consumer and to the trader than the actual charge itself within small limits, for no permanent degree of prosperity can be attained by industries which are unable to move their products with promptitude to consuming centres, and prompt service depends upon adequate physical transport facilities whose provision in their turn rests upon the financial prosperity of the organization owning those facilities. Charges adequate to ensure a steady flow of new capital are essential to any industry, but any narrowing down of this safety margin of efficiency is fraught with more danger to a community in the case of railways than in almost any other productive organization.

National and railway prosperity are interdependent and reactionary upon each other, and an enlightened policy of minimum legislation and regulation by the State should be the corollary of a maximum amount of efficiency and economy by the railways. The importance of railways in the transport work of a country cannot be better expressed than in the words recently used by Herbert Hoover, Secretary of Commerce of the United States :—

" Taking the country as a whole, the railways must ever bear the major burden of our goods traffic. . . . Our railways have reached the highest efficiency in their history and we must maintain them in that condition. . . . With the higher cost of labour and materials we cannot expect any consequential reduction in our railroad rates without ruin to that vital circulating system."

Such a statement is equally true of British railway conditions to-day.

Over one hundred years have passed since the *Sunday Times* [1] stated that " the rail-road coach between Stockton and Darlington, with one horse and 20 passengers performs 11 miles in one hour and a quarter ; the inside fare a shilling, the outside ninepence." As the exchange

[1] *Sunday Times*, March 26th, 1826, price 7*d*.

value of currency has changed, so has the quality of service ; but our technical and economic problems of transportation are still hedged around with difficulty, and it is hoped that this short outline of railway development and transport economics will provide in part a means to unravel so complicated a skein.

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APPENDIX I

SCHEDULE OF STANDARD CHARGES FOR THE CONVEYANCE OF GENERAL MERCHANDISE BY MERCHANDISE TRAIN

(As fixed by the Railway Rates Tribunal, in accordance with Sections 30 and 31 of the Railways Act, 1921.)

STANDARD CHARGES FOR CONVEYANCE.

Class.		First 20 miles or any part. Per ton per mile.	Next 30 miles or any part. Per ton per mile.	Next 50 miles or any part. Per ton per mile.	Remainder of distance. Per ton per mile.
		d.	*d.*	*d.*	*d.*
1	In Owner's Wagons	1·90	0·95	0·55	0·50
2		2·15	1·05	0·70	0·65
3		2·25	1·10	0·80	0·70
4		2·30	1·20	0·90	0·75
5	In Co.'s Wagons	2·60	1·23	0·95	0·75
6		2·65	1·35	1·05	0·80
7		3·05	1·80	1·35	0·95
8		3·20	1·90	1·45	1·00
9		3·40	2·10	1·70	1·15
10		3·50	2·30	1·85	1·25
11		3·65	2·55	2·10	1·45
12		3·75	2·65	2·20	1·60
13		4·05	2·85	2·40	1·75
14		4·40	3·15	2·75	2·15
15		4·75	3·45	3·00	2·25
16		4·80	3·55	3·10	2·35
17		5·35	4·10	3·35	2·55
18		5·50	4·25	3·50	2·75
19		6·40	5·15	4·25	3·50
20		7·50	6·20	5·10	4·30
21		11·25	9·30	7·65	6·45

Note.—In Scotland and on the North Eastern section of the London and North Eastern Railway traffic in Classes 1–4 is only

conveyed in Company's wagons, for the use of which the following additions are made :—For the first 20 miles 0·35*d.*, for the next 80 miles 0·15*d.*, and for the remainder of the distance 0·05*d.* per ton per mile. Fractions of less than ½*d.* in the rate to be dropped, and fractions of ½*d.* or over to be charged as one penny.

STANDARD CHARGES FOR TERMINALS

Class.	Station Terminal at each end.	Service.		Terminals.	
		Loading.	Unloading.	Covering.	Uncovering.
	Per ton.	Per ton.	Per ton.	Per ton.	Per ton.
	s. d.	*s. d.*	*s. d.*	*d.*	*d.*
1 . . .	0 3	—	—	—	—
2 . . .	0 5	—	—	—	—
3 . . .	0 6	—	—	—	—
4 . . .	0 10	—	—	—	—
5 . . .	0 6	—	—	—	—
6 . . .	0 10	—	—	—	—
7 . . .	1 0	0 5	0 5	1·25	1·25
8 . . .	1 2	0 5	0 5	1·25	1·25
9 . . .	1 4	0 5	0 5	1·50	1·50
10 . . .	1 7	0 5	0 5	1·50	1·50
11 . . .	2 0	0 6	0 6	2·50	2·50
12 . . .	2 5	0 8	0 8	2·50	2·50
13 . . .	2 5	0 8	0 8	2·50	2·50
14 . . .	2 5	0 10	0 10	3·00	3·00
15 . . .	2 5	0 11	0 11	3·00	3·00
16 . . .	2 5	1 1	1 1	3·00	3·00
17 . . .	2 5	1 4	1 4	3·00	3·00
18 . . .	2 5	1 7	1 7	3·00	3·00
19 . . .	2 5	2 2	2 2	5·00	5·00
20 . . .	2 5	2 8	2 8	6·00	6·00
21 . . .	3 7	4 0	4 0	9·00	9·00

The standard cartage rates for the country are as follows :—

Classes 11–16 . . . . 2*s.* 6*d.* per ton.
,, 17, 18 . . . . 3*s.* 4*d.* ,,
,, 19, 20 . . . . 4*s.* 2*d.* ,,

As showing the tapering nature of rate scales and the difference in charges made for railway owned and privately owned wagons the following bases of scales are of interest as applying to Coal, Coke, and Patent Fuel, by Merchandise Trains :—

OWNER'S WAGON SCALE ON THE G.W.R., L.M.S.R., L.N.E.R.

	Per ton per mile. d.
First 10 miles	2·25
Next 10 ,,	1·75
,, 30 ,,	1·10
,, 50 ,,	·70
Remainder of distance	·65

while the Company's wagon scale applicable only in Scotland, the North Eastern Area of the London and North Eastern Railway, and to the Southern Railway traffic from Kent Collieries, is

	Per ton per mile. d.
First 10 miles	2·60
Next 10 ,,	2·10
,, 30 ,,	1·25
,, 50 ,,	·85
Remainder of distance	·70

Station terminal at each end . . 5*d*. per ton.

INDEX

Accidents, railway, 163
  causes of, 163
Acworth, Sir William, 318
  Commission in India, 60
Advertising, on railways, 112
Advisory Committees in India, 60
Air Services and competition with railways, 288
Allport, Sir James, 71
Amalgamation, savings of, 303
American Railway Association, 76
  Express Company, 115, 181
Ancillary services : capital of, 31 ; loss and profit on, 41 ; position of, 57 ; revenue from, 40, 42
Annual Reports of Railways, 51, 58, 253
" Appointed Day," the, 62, 90, 93, 95, 106, 109, 117, 190
Aspinall, Sir John, 319
" Atlantic Coast Express " passenger train, 147

Banham, J. L., 65
Belgium Railways, state ownership of, 305
Benches : for freight stations, 175, 176, 182, 188 ; for transhipment sheds, 179 ; length of, 177
" Block " signals, 164
Board of Trade : railway conferences report on German Railway, 63 ; regulation of railways, 45
Bodmin and Wadebridge Railway, ton-mile statistics in 1845, 250
Bonus systems, 187, 315
Brakes : cost of, 193 ; in marshalling yards, 221 ; on freight trains, 193 ; rail, 221 ; shoe, 221 ; standardization of, 160
Branch lines, problem of, 168, 289, 292
Bureau of Railway Economics, Washington, D.C., 126, 254

Cab-signal indication, 165
California Fruit Rate Case, 124
Canadian National Railway, 7 ; ancillary services of, 40 ; locomotive rating of, 157, 158 ; mileage of line of, 251 ; organization of, 13, 21 ; state ownership of, 302, 309
Canadian Pacific Railway, 7
  ancillary services of, 40
Canals, loss on, 41, 287
Capital of railways, 28–40 ; additional raised for betterments, 57 ; authorized, 30, 53 ; characteristics of, 37–39 ; created, 53 ; definition of, 29 ; exchanged when grouping took place, table of, 32 ; expenditure of, 55 ; issued, 30, 54 ; ownership of, 39 ; two main kinds of, 33 ; total expended, table of, 31 ; total receipts, 30
Car-retarders, 221
Car Service Division, 76
Cartage statistics, 280
Cedar Hill Marshalling Yard, 222
Chaddesdon Marshalling Yard, 220, 225
Cheap Trains Act, 111
Chicago, Milwaukee, and St. Paul, use of containers on, 181
Circuitous routes, rates on, 96, 97
Claims, reduction of, for goods, 182, 221, 281
Coal, handling of, on railways, 46, 83, 277
Collection and delivery, rates for, 95, 174
Cologne Marshalling Yard, 222
Colour-light signals, 165
Colson, M., 318
Competing lines, effect of, 39, 104
Competition, road, 286–300, *and* 19, 26, 41, 60, 99, 113, 123, 157, 167, 173, 184, 190, 196, 217, 235, 314

Competition with air transport, 288
with water transport, 287
" Composite " loading of wagons, 186
Congestion on railways, effects of, 102, 113, 140, 213, 228
Conn, Donald, 64
Consignment note, 181, 184
Containers, 180, 181, 319
Control Boards, types of, 211, 212
Control Systems, 206–218
difficulties of, 208, 212
main objects of, 213
methods of working, 211
of wagons, 214, 218
use of, in the United States, 206
on the L.M.S.R., 206, 207, 209
on the L.N.E.R., 209, 210
Conveyance of Mails Act, 114
Co-operation with road interests, 300, 314
with the trader, 59–70, 216, 315
benefits of, 59
importance of, 60
in France, 61
in Germany, 63
in India, 60
in the United States, 64
" Cornish Riviera Ltd." passenger train, 147, 169
Costing problem, 318
Costs, 117, 133, 156, 161, 188, 286
of delays, 199
of stopping and re-starting a freight train, 194
a passenger train, 170
per ton per man-hour, 188
per mile, 102
Coupling of wagons, dangers of, 193
Cranes, 177, 180, 188
Crewe Marshalling Yard, 225
Crewe transhipment station, working of, 185
Cunningham, Professor, 318

Debentures, or bonds: capital raised by, 55; definition of, 33; description of, 34; proportion of, to stocks, 36, 53
Delaware, Lackawanna, and Western Railroad, conversion of old track to highway, 37
Delays, reduction of, 208, 275
Deloison brake, 221
Demand, chart showing elasticity of, 38
Demurrage, 74, 119
Departmental organization, 17
chart of, 18
Despatching system, 191, 206
District Councils, in Germany, 63
Divisional organization, 17, 19
chart of, 20
Docks, railway, 41, 182, 203
Double-heading of locomotives, 159, 197

Eight-hour day, diagram of working, 196
effect of, 195, 200
Electric locomotive stock, 247
Electric traction, 230–248, *and* 9, 101, 142; advantages of, 231; difficulties of comparing cost with steam traction, 230; future of, 247, 248; history of, in Great Britain, 232–243; in the United States, 232; locomotives for, 247; multiple-unit trains for, 234, 236, 240, 247; on the Continent, 232; overhead system, 236; statistics of, 243–246; third-rail system, 238
Elliott, Howard, 253
Empty train mileage, elimination of, 149
Engineering departments, difficulties of organization, 24, 25
Entrepôt trade of Great Britain, 190
" Equated tonnage " of freight trains, 158
Etat Railway of France, operating ratio of, 49
state ownership of, 302, 309
Expenditure: railway, 45–51; estimate of further, 55; fixed or overhead, 46, 47, 49, 113; general, 49; in respect of railway working, 57; problem of division of, 44, 132; public demand for, 126; savings on, 48; tables of, 42, 50; two main features of, 45; variable, 46, 49

Fares, passenger: chart of, 99; competitive, 295; duty on, 98; equal mileage, 98, 100, 101; excursion, 111, 113; pre-war, 98; principles of, 98; season ticket, 108,

109; standard, 98; terminal costs included in, 100; theory of, 81–130; tourist, 111, 113; trader's ticket, 110; workmen's, 111
Federation of British Industries, 61
Finance, 28–58
  sources of information of, 51
Financial structure of British railways, 36
Fink, Albert, 317
Freight cars: capacity of (U.S.), 222; census of, by the Railway Clearing House, 75; common user of, 76, 213; "composite" loading of, 186; control of, 214, 218; full loading of, 183; high capacity, use of, 60, 191, 263; loading of, 176; minimum load for, 184, 319; privately owned, 81, 118, 173, 193, 227; proportion of covered to open, British and Continental, 173; "road," 176, 185; standard for mineral traffic, 191
Freight Classification, 86, 190
  classes of, 87
  table of, 88
Freight station: Bristol, 188; cartage at, 173, 175; Crewe, 185; Curzon Street, Birmingham, 182; design, 174, 175; inside working of, 180, 189; problems of operation of, 25, 175; through type of, 176; wayside, 179
Freight traffic receipts, 43, 49, 57, 78, 262
  percentage of, 133
  statistics of, 278, 279
Freight train operation, 172–205
  main characteristics of, 172
Freight train service, 189–201; differences of, compared with passenger train service, 189, 190; problems of, 190; time-tables of, 192
Freight trains: average weight of, 200; balanced working of, 199; formation of, 102; haulage of, 101; naming of, 192; speed of, 194; turn-round of locomotives for, 196
French Railways: braking in marshalling yards on, 221; co-operation with the trader, 61; demurrage on, 121; freight service of, 193; internal organization of, 14; state ownership of, 305; stationmaster's position on, 154; suburban traffic of, 109

Georgia Public Service Commission, 126
German Railway Company, 8; ancillary services of, 40; braking in marshalling yards on, 221; demurrage on, 121; District Councils of, 63; freight time-tables of, 189; internal organization of, 13; marshalling yards of, 218, 223; state ownership of, 305, 309
Gibson Marshalling Yard, 222
"Golden Arrow" passenger train, 147
Government operation of railways, 49
Granet, Sir Guy, 57
Great Western Railway: Bristol freight station of, 188; docks of, 203; electrified section, 234; internal organization of, 22; milk trains of, 116; mineral trains of, 194; non-stop trains of, 169; road services of, 291; stock of, 36; suburban traffic of, 142
Gross ton-mile, importance of, 203
Guard's journal, importance of, 201, 275
  for marshalling yard working, 226

Hamm Marshalling Yard, 223, 224
Hartford Marshalling Yard, 222
Hill, James J., 253
Hoch-Smith Resolution, 124
Hoover, Herbert, Secretary of Commerce, U.S., 67, 320
Hotels, railway, 40, 41
Hours of work, 41
  and Washington Treaty, 298
Hurcomb, Cyril, 293

India, railways of, 9
  Advisory Committees of, 60
Interlocking, 164, 199

Internal combustion engine (Diesel), 231
Interstate Commerce Commission, 15, 83, 94, 124, 130, 133, 254, 299, 319
Iron and Steel Trades Federation, 61

Joint lines, mileage of, 257
" Journey Time Slip," 184

Kunz-Knorr brake, 193

La Follette Act, 1913, 35
Labelling of goods, 181, 182, 184
of wagons (freight cars), 176, 202
Lee, Elisha, 66
Lille (La Délivrance) Marshalling Yard, 220
Liverpool Overhead Electric Railway, 232
Liverpool Street Station (London), rush-hour traffic of, 295
Load rating of freight trains, 203
Loading gangs, organization of, 187
Loading of trains: freight, 173, 183
passenger, 139, 160
Local Joint Committees, 62
Locomotive: statistics of, 258; life of, 260; table of effective work in marshalling yard, 223
Locomotive crews, hours of, 152, 200
power, rating of, 157, 159
running, long-non-stop, freight, 228; passenger, 152, 169
running expenses, 45, 48
working schedules: charts of, 151; designing of, 150; objects to avoid, 151
Locomotives awaiting repair, percentage of, 261
London, Midland and Scottish Railway: additional capital, 57; capital of, 30; electrified sections of, 234; freight stations of, 182, 185; internal organization of, 21, 24; locomotive rating of, 157; marshalling yards of, 225; milk trains of, 116; non-stop trains of, 169; number of employees on, 251; stocks and shares of, 36; suburban traffic of, 142; track mileage of, 256; traffic control on, 206, 209; wagon control on, 215
London and North Eastern Railway: chart of internal organization of, 23; debentures of, 37; docks of, 203; electrified sections of, 234, 246; marshalling yards of, 224, 225; milk trains of, 116; non-stop trains of, 169; stocks and shares of, 35, 36; suburban traffic of, 142, 148; track mileage of, 256; traffic control on, 209, 211
Lorries, use of, for less-than-carload traffic, 297
for unloading freight traffic, 180, 291

Maintenance and Renewal of rolling stock, 45, 47, 58, 261
of way and works, 44, 47, 58, 260
Market competition, widening of, 4, 5, 80, 127
price, effects of rates on, 127
Markham Marshalling Yard, 222
Marshalling Yards, 218–228; accidents in, 163; Blue Island, 222; braking in, 193; Cedar Hill, 222; Cheddesdon, 225; Cologne, 222; Crewe, 225; double-end working of, 219; Edgehill (Liverpool), 225; Erimus, 209; flat type, 218; Gibson, 222; gravity, 219; Hamm, 223, 224; Hartford, 222; hump, 219; ladder design of, 220; layout of, 219; lighting of, 220; Markham, 220; New England (Peterboro'), 225; Newport, 209; objects of, 218; plan of Whitemoor, 226; Potomac, 222; table of work done by locos. in, 223; Toton, 225; Whitemoor, 224; Wüstermark, 222
McGahey skid-placing machine, 222
Mersey Railway, 233
Metropolitan Railway, 233
Metropolitan District Railway, 233
Midland Railway, traffic control on, 207

Mileage of railway lines per 1,000 of population, 43
Milk: carriage of, by passenger train, 108, 116, 167
costs of, 117
receipts from, 167
Mining Association, 61
Minister of Transport, 28
Ministry of Transport, 29, 51, 132, 136, 224, 253, 316
Ministry of Transport Act, 52, 255
Morison, Kenneth, 71
Motor-bus services run by railways, 291, 292, 314

National agreements, for hours of work, 41
National Wages Board, 39
Net income of railways, 50
proposed appropriation of, 57
Newspapers, carriage of, by passenger train, 114
Nord Railway of France: Lille marshalling yard, 220; signal indication on, 165; steamers of, 40

Operating Department, 24, 26, 208 and time-tables, 146
Operating efficiency, 147, 155, 156, 162, 179, 197, 224, 277
problem, a typical, 168
ratio, 49, 278
statistics, 251
superintendent, problems facing an, 156, 172
Operation: differences of, 133; of freight trains, 172; of passenger trains, 132, 171
Organization, internal, of railways, 12–27; an outline chart of, 27; chart of typical pre-war, 16; departmental, 17; divisional, 17, 19; function of, 12; in Canada, 13; in France, 14; in Germany, 13; in Great Britain, 15, 16; in Poland, 14; in the United States, 13, 15; problems of, 22–26

Packing of freight, methods of, 181
Parcels by passenger train, 103, 114, 116, 167
platforms for, 139
Parliamentary Trains, 98
Parmelee, Dr. Julius H., 254
Passenger carriage sets, 147, 148
weight of, 148
Passenger traffic: average fare for, 262; defined, 2; percentage of, 133; receipts, 43, 49, 57, 78, 156; table of, 294
Passenger train operation, 132–171; characteristics of, 134; compared with freight, 133; problems of, 139
Paths for freight trains, 192
for passenger trains, 160, 207
Platforms: length of, 135, 137; Ministry of Transport regulations for, 136; movable for freight stations, 176; occupation lists for, 155
Post Office (Parcels) Act, 114
Post Office traffic, 78, 103, 113, 114, 167; division of receipts from, 115; state ownership of, 307
Potomac Marshalling Yard, 222
Price, P. H., 73
Price of money, effect on rates, 126
Prices per ton, chart of, 85
Private sidings, charges for, 118
Pullman cars, 170
Punctuality: on railways, 162, 197; necessity for, of freight trains, 198; problems of, 162; statistics, 275

"Queen of Scots" passenger train, 147

Rail brakes in marshalling yards: Frolich, 222; Hannauer, 222; Jordan, 222
Rail motors: cost of, 290; services, 289, 290; statistics, 259
Railway and Canal Commission, 61, 95
Railway Clauses Act, 254
Railway Clearing House, 71–80; Act of, 72; Amalgamation scheme of, 72; coaching department of, 78; effect of, 79; Executive Committee of, 73; growth of, 72; inauguration of, 71; merchandise department of, 77; mileage department of, 74; objects of, 73; secretarial department of, 73
Railway Companies (Accounts and Returns) Act, 1911, 51, 254

Railway Companies Bills, presentation of, to Parliament, 28
Railway construction, its economic effect, 3–6
Railway Rates Tribunal, 39, 62, 69, 94, 98, 107, 119, 317
Railways Act, 1921, 52, 62, 69, 105, 121, 169, 174, 255
Rates and circuitous routes, 96, 97; blanket system of, 103, 127, 130; chart of, 105; competitive, 287; demurrage, 119; disintegration of, 96; equal mileage, 92; exceptional, 87, 93, 94, 104, 130; for collection and delivery, 95; in relation to cost, 82, 85; level of, 61, 127; lower limit of, 83; maximum limit of, 83; origin of, 82; on traffic by passenger train, 106, 114; owner's risk, 106; per ton chart, 91; principles of, 129; reduction of, 125; standard, 88, 89, 90, 91; station to station, 96; table of increases and decreases, 122; tapering, 93, 102; terminal, 96, 102; theory of, 81–130; undue preference and, 95, 122, 124; "What the traffic will bear," 83, 84; zone, 102; zone principle chart, 103
Rates Advisory Committee, 61
Receipts: from freight traffic, 43, 49
table of, 44
from passenger traffic, 43, 49
table of, 44
in respect of railway working, 57
Regulation of Railways Act, 1840, 254; 1868, 255; 1871, 254
Reparations Commission, 309
Reserves, withdrawals from, 42
Restaurant cars and refreshment rooms, 41
Retail production and railways, 319
Revenue, 40–45; and Government regulation, 39; load per freight train, 55; receipts of four British railways, 40, 41; receipts, tables of, 42; standard, 62, 121, 123, 129; turnover of, compared with capital, 37
Road competition with railways, 286–300, *and* 19, 26, 41, 60, 99, 123, 157, 167, 173, 184, 191, 196, 235, 314; abroad, 299; branch line services and, 290, 292; freight services and, 296; main advantages of, 289; regulation of, 298; season ticket holder and, 292; subsidization of, 298; use of lorries and, 296
Road vehicles, operation of, by railways, 41, 174, 291
"Road" wagons, 176, 185
Rolling stock equipment, 45, 47, 55; chart of working, 148; control of, 147, 150, 213, 217; statistics of, 259
"Royal Scot" passenger train, 147, 169
Running Department, 25, 208
Running sheds, position of, 143
Rush-hour traffic, 108, 112, 169, 237
at Liverpool Street Station, 295

Safety on railways, 162
Season tickets, 108, 109, 292
table of, on the Great Eastern Railway, 294
Shippers Advisory Boards (U.S.), 64, 263; Commodity Committees of, 65; objects of, 68; railroad contact committee of, 65; success of, 66, 67
Sidings in marshalling yards, 219, 220
Signalling: automatic, 164; block, 164; cab indication for, 165; colour light, 165; interlocking of, 164; power, 164
Southampton docks, handling of freight at, 182, 204
"Southern Belle" passenger train, 147
Southern Railway: colour lights on, 166, 242; electrified sections of, 232, 235–243; internal organization of, 22, 24; milk trains of, 116; stock of, 36; suburban traffic of, 112, 142
Speed, cost of, 161, 169
of freight trains, 194, 195
Standard charges for merchandise in railway wagons, 91
State ownership, 301–311; advantages of, 306, 310; dis-

advantages of, 307; of Continental railways, 305; operation of railways under, 308; reasons for, 305
State regulation: growth of, 51; of railway dividends, 39; of railways, 301, 302, 303
Statistics, 249–285; average fare per passenger, 262; average rates for freight, 262; average wagon-load, 266; cartage and delivery, 174; choice of, 274; coaching train-miles per train-hour, 149; control by means of, 253; effectiveness of, 282; engine-miles per engine-hour, 152; external, or Government, 249; for freight traffic, 278, 279, 280; for passenger traffic, 280; graphs of, 283, 284; gross ton-mile, 283; gross ton-miles per train-hour, 194, 198, 253; importance of, 252, 316; internal, or railway, 274; loaded train-miles, 149; locomotive, 258, 261; main sources of, 253; mileage, 255–258; net ton-miles, 268, 283; of claims, 281; of electric traction, 243–246; of freight trains, 60; of locomotive coal, 277; of marshalling yards, 222, 224–228; of operation, 261; of output, 276; of season ticket holders, 293; punctuality, 275; reasons for, 249, 250, 251; receipts per ton-mile, 265; rolling stock, 259; shunting-hour, 267; sources of information of, 51; strength of, 285; the ton-mile, 249, 257, 263; the train-mile, 269, 270, 271, 319; ton-miles per engine-hour, 257, 266; train-miles per engine-hour, 152, 271, 272; wagon-miles, 272, 273
Station-master, the duties of, 153–156, 282; diagram of responsibility of, 153; in France, 154
Stations: design of, 135–142; roadside, 136; terminal, 40, 135, 138
Stephenson, Robert, 71
Stocks and shares: definition of, 33; description of, 35; dividends on, 50; proportion of, to debentures, 36, 53; reduction of classes of, 54; splitting of, 36; trustee, 40
Suburban traffic, 109, 111, 112, 141, 147, 295
and electrification, 234–243
loss on, 109
Superior Railway Councils of France, 61
Swiss Railway, state ownership of, 305

Taxes on railways, cost of, 49, 51, 57, 298, 313
Terminal charges, 95
stations, ownership of, 40
Thompson, Slason, 254
Thornton, Sir Henry, 7, 13
Through carriages, 149
Time-tables: construction of, 142, 143, 145; design of, 141–149; diagrams for working, 144; in freight stations, 177
Tolls on railways, 81
Tonnage of trains, 201, 202
Total Capital Expenditure, 31
Receipts, 30
Toton Marshalling Yard, 225
Track capacity, problems of, 160
circuits, 164
layout, 102, 135, 140
problems of, 139
Tractors, 188
Tramways, tables of, 294
Tranship shed: design of, 178
diagram of layout of, 179
Tranship stations, 176, 177; advantages of, 183; diagram of layout of, 178; disadvantages of, 184; objects of, 178; principles of loading at, 185
Trade Unions, 188
Traders' Co-ordinating Committee, 62, 69
Traders' tickets, rates on, 110
Traffic, passenger, 44; expenses, 45, 48, 49; freight, 44; freight by passenger train, 107, 117, 167; international, 94; loss on, 44
Train control, automatic, 164
systems of, 206–208
Train-load, decrease in, 196

Transportation Act of 1920 (U.S.A.), 35, 125, 169
Transportation in relation to selling price, 9
Trucks for handling freight, 182
Trustee Act, 40
Turton, Sir Edmund R., 73

Underground Railway; colour-lights on, 166; electrification of, 233; time-tables of, 145
United States railways: assistance to unification of, 7; block signalling on, 164; braking in marshalling yards, 221; circuitous routes on, 97; colour-light signals on, 166; demand for lower rates on, 128; demurrage, 119, 120; despatching system on, 191, 206; employees, number of, 47; Government operation of, 64; leased mileage of line, 257; naming of freight trains, 93; net capitalization of, 53; rates on, 125; railroad calendar of expenditure, 51; "safety first" campaign, 163; Shippers' Advisory Boards, 64; station design on, 138; statistics of, 253, 254, 282; suburban traffic of, 109; track mileage of, 256; trader's tickets on, 110; uniform fares on tube railways of, 103; zone principle of rates, 103
Unloading gangs: composition of, 181
organization of, 187

Wages: level of, 122
theory of, 49, 315
Wagons: capacity of (U.S.), 222; census of, by the Railway Clearing House, 75; common user of, 76, 213; "composite" loading of, 186; control of, 214, 218; full loading of, 183; high capacity, use of, 60, 191, 263; loading of, 176; minimum load for, 184, 319; privately owned, 81, 118, 173, 193, 227; proportion of covered to open, British and Continental, 173; "road," 176, 185; standard for mineral traffic, 191
Warehouse accommodation on the L.M.S.R., 314
Water transport in Great Britain, 3, 4, 287
Western Union Company, 307
Westinghouse brake, 193
Wolverton, Lord George Carr Glyn, 71
Workmen's fares, 111
Wüstermark marshalling yard, 222

Yardmaster, the duties of, 226, 282
Yearly returns, 253

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